Online Help
Leica GeoMoS v5.1

- when it has to be right

Leica Geosystems

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Introduction to GeoMoS

Introduction

GeoMoS is a system to permanently observe movements of objects such as buildings, dams and slopes. GeoMoS checks the measurements and results against user defined limits. If a limit has been exceeded a message can be sent. The measurement and results can be analyzed with a special application. It is possible to connect different sensors (total stations, GNSS, meteo, geotechnical). The position of a total station instrument can be defined with GNSS or reference points.

The system also contains

- a sophisticated measurement cycle manager,
- different modern and flexible communication possibilities (cable, bus system, radio, LAN, WLAN, GSM/GPRS, UMTS and WiMax),
- automatic calculation functionality and,
- a variety of graphical and numerical representations of measurements and results.

GeoMoS consists of two main components: Monitor and Analyzer.

The network adjustment and deformation analysis software GeoMoS Adjustment complements the Analyzer component.

GeoMoS Monitor

is responsible for sensor maintenance, measurements, storing data, computing results, measurement and result checks and message generation.

GeoMoS Analyzer

is responsible for analyzing the measurements and results. It also has print and export capabilities.

GeoMoS Adjustment

is responsible for the automatic network adjustment and deformation analysis. It also has network simulation capabilities.

Important Notes

Topic contents

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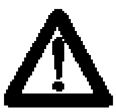
In order to use the software correctly and reliably, you must follow the instructions given in the online help system. You must also adhere to the directions given in the user manual for the product with which you are using the software and the user manual of the manufacturer of the sensor and control equipment.

The rights and responsibilities accruing in respect to Leica Geosystems AG as a result of acquisition of the software are set out in the **Leica Geosystems AG Software License Agreement**.

All of the instructions and directions required for a technical specialist to use the system are included in the online help system, which are only available in English and German.

Symbols used

The symbols used in this online help system have the following meanings:



DANGER:

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING:

Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.

CAUTION:

Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor or moderate injury and / or appreciable material, financial and environmental damage.

Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

Trademarks

Windows is a registered trademark of Microsoft Corporation.

All other trademarks are the property of their respective owners.

Safety directions

The following directions should enable the person responsible for the product, and the person who actually uses the product, to anticipate and avoid operational hazards.

The person responsible for the product must ensure that all users understand these directions and adhere to them.

Intended use of the product

Permitted uses

GeoMoS is intended for the following applications:

- temporary or permanent monitoring installations
- connection, control and run of different sensors (e.g. total stations, GNSS)

- collection, storage and presentation of measurement data
- computation, evaluation and post-processing of data

Prohibited uses

- Use of the product without instruction
- Use outside of the intended limits
- Disabling safety systems
- Modification or conversion of the product
- Use after misappropriation
- Use with accessories from other manufacturers without the prior express approval of Leica Geosystems
- Use of the product as an alarm management system
- Use as an exclusive measurement system for monitoring of deformation measurement

WARNING:

Adverse use can lead to injury, malfunction, and damage. It is the task of the person responsible for the product to inform the user about hazards and how to counteract them. The product is not to be operated until the user has been instructed how to work with it.

Responsibilities

Area of responsibility of the manufacturer of the original equipment LEICA Geosystems AG, CH-9435 Heerbrugg, Switzerland (hereinafter referred to as Leica Geosystems):

Leica Geosystems is responsible for supplying the product, including the online help system and original accessories, in a completely-safe condition.

Responsibilities of the manufacturers of non-Leica Geosystems accessories:

The manufacturers of non-Leica Geosystems accessories for the product are responsible for developing, implementing and communicating safety concepts for their products, and are also responsible for the effectiveness of those safety concepts in combination with the Leica Geosystems product.

Responsibilities of the person in charge of the product:

WARNING:

The person responsible for the product must ensure that it is used in accordance with the instructions. This person is also accountable for the training and the deployment of personnel who use the product and for the safety of the equipment in use.

The person in charge of the product has the following duties:

- To understand the safety instructions on the product and the instructions in the online help system;
- To be familiar with local regulations relating to accident prevention;
- To inform Leica Geosystems immediately if the product becomes unsafe.

Hazards of use

Main hazards of use

WARNING:

The absence of instruction, or the inadequate imparting of instruction, can lead to incorrect or adverse use, and can give rise to accidents with far-reaching human, material, financial, and environmental consequences.

Precautions:

All users must follow the safety directions given by the manufacturer and the directions of the person responsible for the product.

CAUTION:

Watch out for erroneous measurements if the product has been misused or modified.

Precautions:

Periodically carry out test measurements and perform the adjustments indicated in the online help system, before and after important measurements.

WARNING:

Unforeseeable events may cause disturbances, breakdowns or defects in the system hardware or in the GeoMoS software. E.g. power failures, computer viruses, sensor failures, network breakdowns can limit or disrupt system functions. As a result of the above, monitoring shifts in buildings, embankments, dams, structures, etc. may no longer be carried out properly.

Precautions:

Measured results are to be checked for their plausibility and verified continuously using a second, redundant measuring system. GeoMoS is not an alarm system for further action, but exclusively a measuring system. The user has to interpret the measurements and decide on the appropriate measures to take.

WARNING:

Improper installation and maintenance of the measuring system (sensors, network and software) may cause errors in measurements or reliability problems.

Precautions:

Your measuring system should only be installed and operated by an authorized technician, also for implementing measures that improve reliability, e.g. installation of an uninterrupted power supply, a Watchdog PC card, etc.

The system’s measuring accuracy is to be verified and checked for plausibility after installation.

System components are to be protected against adverse influences from the surroundings and from the environment. Set preventive and regular maintenance intervals for your system components.

By keeping replacement components in stock, the system is quickly restored in case of a failure.

Regularly back up and check your data.

WARNING:

Spontaneous and abrupt movements and shifts in the monitored objects cannot be detected by the GeoMoS system.

Precautions:

Do not use the GeoMoS system as a stand alone measuring system to monitor spontaneous and abrupt movements of objects.

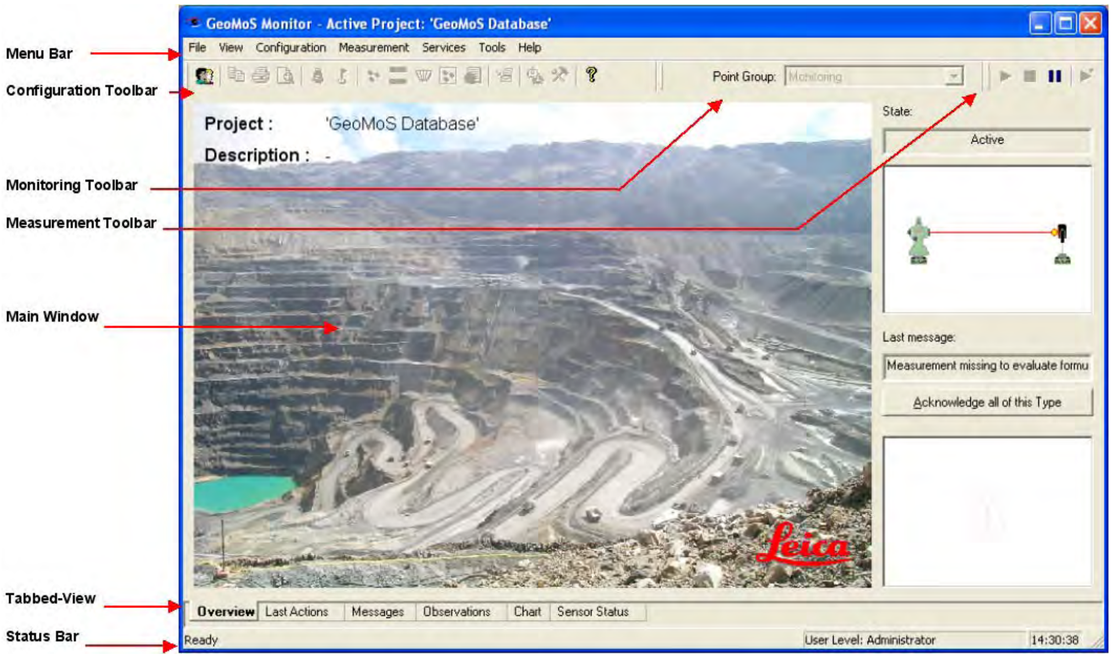
User Interface - Monitor

General

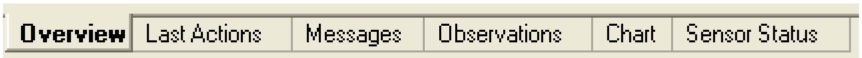
The GeoMoS graphical user interface (GUI) has been designed to be simple and efficient to use and configure.

The design of the Monitor GUI is based around tab views, which enable you to switch between the key information displays quickly and easily with a single mouse click.

The default appearance of the GeoMoS GUI consists the following main components:



Part	Function
Menu Bar	The Menu Bar is a special Toolbar at the top of the screen that contains the menus File, View, Configuration, Measurement, Tools and Help. The Menu Bar lists the available commands. If a command is not applicable it is grayed out and not accessible.
Configuration Toolbar	Toolbars allow you to organize the commands you use most often the way you want to, so you can find and use them quickly. The configuration toolbar

	contains shortcuts to all of the menu options that are needed to configure the system.
Monitoring Toolbar	Toolbars allow you to organize the commands you use most often the way you want to, so you can find and use them quickly. The monitoring toolbar contains shortcuts that allow you to easily to select another point group for manual measurement.
Measurement Toolbar	Toolbars allow you to organize the commands you use most often the way you want to, so you can find and use them quickly. The measurement toolbar contains shortcuts to start and stop manual and automatic measurement.
Main Window	The main window contains the main content of the selected tab.
Tabbed-View	Upon opening GeoMoS, tabs at the bottom of the view allow you to quickly switch from one view to another. 
Status Bar	The status bar shows important system information such as the current activity, the user level and the time.

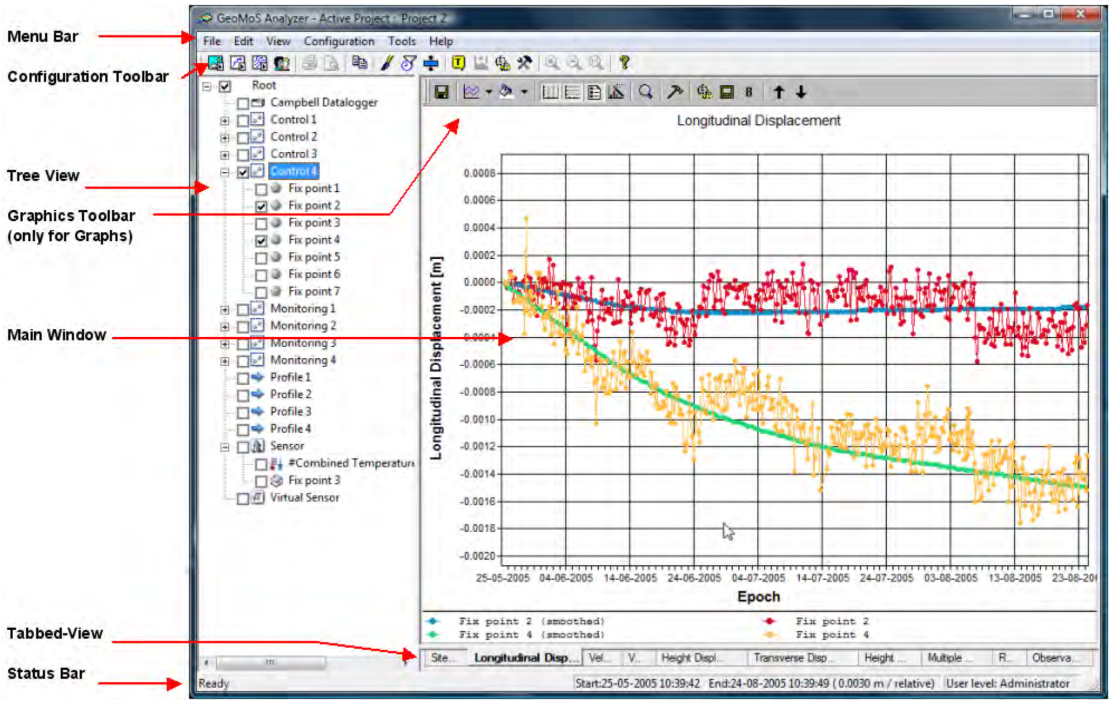
User Interface - Analyzer

General

The GeoMoS graphical user interface (GUI) has been designed to be simple and efficient to use and configure.

The look of the GUI is very similar to that of Microsoft Windows Explorer with a collapsible tree view in the main window’s left pane and a property view in the right pane. With this presentation approach the user can access information from anywhere without needing multiple windows.

The default appearance of the GeoMoS GUI consists the following main components:



Part	Function
Menu Bar	The Menu Bar is a special Toolbar at the top of the screen that contains the menus File, Edit, View, Configuration, Tools and Help. The Menu Bar lists the available commands. If a command is not applicable it is grayed out and not accessible.
Configuration Toolbar	Toolbars allow you to organize the commands you use most often the way you want to, so you can find and use them quickly. The configuration toolbar contains shortcuts to many of the important menu items used to aid the analysis of the data.

Tree View	The tree view contains a list of all point groups and all profiles configured in the system. Under each point group/profile are listed all of the points contained in that point group/profile. By activating and deactivating points it is possible to control which points are shown in the graphs in the main window.
Main Window	The main window shows the graph or report as indicated by the tab view.
Graphics Toolbar	The graphics toolbar may be used to control the display and formatting of the graphs.
Context Menu	With a right-click on the Main Window, a Context-Menu is available. A Context-Menu lists all useful commands at a particular instant for a particular item on the screen.
Tabbed-View	Upon opening GeoMoS, tabs at the bottom of the view allow you to quickly switch from one view to another. Click on each tab to learn more. 
Status Bar	The status bar contains important analysis information such as the start and end time of the display and the display options.

Quick Start

Tour I: Configure an instrument or sensor

Objective

In this Quick Tour you will learn how to prepare and configure a Leica total station, GNSS sensor or inclination sensor for monitoring purpose.

Important:

- Leica instruments are manufactured, assembled and adjusted to the best possible quality. Quick temperature changes, shock or stress can cause deviations and decrease the instrument accuracy. It is therefore recommended to check and adjust the instrument (refer to the User Manual of the instrument) in the following situations:
  - before the first use
  - before every high precision survey
  - after rough or long transportations
  - after long working periods
  - after long storage periods
  - if the temperature difference between current environment and the temperature at the last calibration is mor than 20°C.
- The EDM mode, the additive constant for prisms and the PPM corrections of total stations will be handled with the GeoMoS Monitor software. Do not set the EDM mode, the additive constant for prisms and the PPM corrections in the total station!

Procedure

Follow these steps to configure an instrument or sensor.

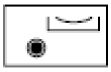
Action
Leica TPS1800 and TPS2003 instruments
Levelling-up with the electronic bubble
GSI communication settings
GeoCOM communication settings
Deactivate the Sleep Mode
EDM Mode

GPS1200
NMEA Out 1 - communication settings
NMEA Out 1 - messages settings
Rover antenna settings
RTK corrections (reference antenna) settings
Leica Sprinter instruments

Leica TPS1800 and TPS2003 instruments

Levelling-up with the electronic bubble

Follow these steps to level up with the electronic bubble.

Step	Action
1	Press on the total station the button .
2	The longitudinal and transverse tilt of the instrument's vertical axis is displayed graphical and numerical.
3	Using the footscrews, the instrument can be levelled-up.

GSI communication settings

Follow these steps to configure the GSI communication settings.

Step	Action
1	Go to the **Main Menu: Programs**.
2	Select the **F3 (CONF)** button.
3	The **CONF\ SYSTEM CONFG.** panel appears.
4	Select **3 GSI communictions param.**.
5	The **CONF\ GSI COMMUNICATION** panel appears. Set the following GSI communication parameters:

	Baud rate Protocol: GSI Parity: No Terminator: CR LF Data bits: 8 **Note:** If using the switchbox it is essential to configure the baud rate to 9600.
6	Confirm the settings with **CONT**.

GeoCOM communication settings

Follow these steps to configure the GeoCOM communication settings.

Step	Action
1	Go to the **Main Menu: Programs**.
2	Select the **F3 (CONF)** button.
3	The **CONF\ SYSTEM CONFG.** panel appears.
4	Select **4 GeoCOM communictions param.** .
5	The **CONF\ GeoCOM COMMUNICATION** panel appears. Set the following GeoCOM communication parameters: Baud rate Protocol: GeoCOM Parity: No Terminator: CR LF Data bits: 8 **Note:** If using the switchbox it is essential to configure the baud rate to 9600.
6	Confirm the settings with **CONT**.

Deactivate the Sleep Mode

Follow these steps to deactivate the Sleep Mode.

Step	Action
1	Go to the **Main Menu: Programs**.
2	Select the **aF...** button.
3	The **aF...\ ADDIT. FUNCTIONS** panel appears.
4	Select from the menu **7 Power off, Sleep**.
5	Select from the list box **Remains ON**.
6	Confirm the settings with **CONT**.

EDM Mode

GeoMoS sets automatically the precise mode for TCA1800 and TCA2003 instruments.

PPM settings

Follow these steps to configure the PPM settings.

Step	Action
1	Go to the **Main Menu: Programs**.
2	Select the **F6 (MEAS)** button.
3	The **MEAS\ MEASURE MODE** panel appears.
4	Select the **F4 (TARGT)** button.
5	The **MEAS\ TARGET DATA** panel appears.
6	Select the **F2 (PPM)** button.
7	The **MEAS\ ATMOSPHERIC CORR.** panel appears.
8	The standard values **Temperature = 12°**, **Atm. press. = 1013.3mBar** and **Rel. humid. = 60%** must be set.

9	To set the standard values select the **F5 (ATM=0)** button.
10	Confirm the settings with **CONT**.

Note: The ppm correction must be determined within GeoMoS.

Additive Constant

Follow these steps to configure the Additive Constant.

Step	Action
1	Go to the **Main Menu: Programs**.
2	Select the **F6 (MEAS)** button.
3	The **MEAS\ MEASURE MODE** panel appears.
4	Select the **F4 (TARGT)** button.
5	The **MEAS\ TARGET DATA** panel appears.
6	Select the **F1 (PRISM)** button.
7	The **MEAS\ PRISM SELECTION** panel appears.
8	The additive constant for the **Leica circ. prism** must be set to **0.0mm**.
9	Confirm the settings with **CONT**.

Note: The additive constant is set in the GeoMoS Point Editor dialog for each point.

Online-mode

Follow these steps to configure the Online-mode.

Step	Action
1	Go to the **Main Menu: Programs**.
2	Select the **F1 (EXTRA)** button.

3	The **EXTRA\ EXTRA FUNCTIONS** panel appears.
4	Select from the menu **1 On-line mode (GeoCOM)**.
5	The **NOTICE: 59** "Switches to on-line mode. Do you want to switch?" appears.
6	The **F5 (YES)** button activates the "On-line mode". The operation of the instrument is now totally controlled acorss the interface.

Note: The on-line mode can be quitted only by pressing the **ON/OFF** button.

Auto-Start configuration

Follow these steps to configure Auto-Start.

Step	Action
1	Go to the **Main Menu: Programs**.
2	Select the **F3 (CONF)** button.
3	The **CONF\ SYSTEM CONFG.** panel appears.
4	Select **6 Autoexec-application** .
5	The **CONF\ SYSTEM CONFG.** panel appears.
6	Choose the **Main menu** application. The chosen function/application is started automatically every time the instrument is switched on.
7	Confirm the settings with **CONT**.

Leica TPS1200 and TM30/TS30 instruments

Levelling-up with the electronic bubble

Follow these steps to level up with the electronic bubble.

Step	Action

1	Press on the total station **SHIFT** and then **F12**.
2	The longitudinal <**Tilt L:**> and transverse <**Tilt T:**> tilt of the instrument's vertical axis is displayed graphical and numerical.
3	Using the footscrews, the instrument can be levelled-up.

GeoCOM communication settings

Follow these steps to configure the GeoCOM communication settings.

Step	Action
1	Go to the **Main Menu**.
2	Select the **5 Config...** menu.
3	The **TPS1200 Configuration** panel appears.
4	Select the **4 Interfaces...** menu.
5	The **CONFIGURE Interfaces** panel appears.
6	The **Interface GeoCOM Mode** on **Port 1** with the **Device RS232 GeoCOM** must be in use.
7	To set the communication parameters select on the **CONFIGURE Interfaces** panel **EDIT (F3)**.
8	The **CONFIGURE GeoCOM Mode** panel appears.
9	Select the **DEVCE (F5)** button.
10	The **CONFIGURE Devices** panel appears.
11	Select the **EDIT (F3)** button.
12	The **CONFIGURE Edit Device RS232 GeoCOM** panel appears. Set the following GeoCOM communication parameters: Baud rate Parity: None Data Bits: 8 Stop Bits: 1

	Note: If using the switchbox it is essential to configure the baud rate to 9600.
13	Store the settings with the **STORE (F1)** button.

Deactivate the Sleep Mode

Follow these steps to deactivate the Sleep Mode.

Step	Action
1	Go to the **Main Menu**.
2	Select the **5 Config...** menu.
3	The **TPS1200 Configuration** panel appears.
4	Select the **3 General Settings...** menu.
5	The **CONFIGURE General Menu** panel appears.
6	Select the **6 Start Up & Power Down** menu.
7	The **CONFIGURE Start Up & Power Down** panel appears.
8	Set the **Auto Power Down Behaviour Mode** to **Remain On**.
9	Confirm the setting with **CONT (F1)**.

EDM Mode and Additive Constant

Follow these steps to configure the EDM Mode and Additive Constant.

Step	Action
1	Go to the **Main Menu**.
2	Select the **5 Config...** menu.
3	The **TPS1200 Configuration** panel appears.
4	Select the **2 Instrument Settings...** menu.
5	The **CONFIGURE Instrument Menu** panel appears.

6	Select the **1 EDM & ATR Settings** menu.
7	The **CONFIGURE EDM & ATR Settings** panel appears. Set the following parameters: EDM Type: Reflector (IR) EDM Mode: Standard Reflector: Leica Circ Prism Add. Constant: 0.0mm Automation: ATR
8	Confirm the settings with **CONT (F1)**.

Note: The additive constant is set in the GeoMoS **Point Editor** dialog for each point.

PPM settings

Follow these steps to configure the PPM settings.

Step	Action
1	Go to the **Main Menu**.
2	Select the **5 Config...** menu.
3	The **TPS1200 Configuration** panel appears.
4	Select the **2 Instrument Settings...** menu.
5	The **CONFIGURE Instrument Menu** panel appears.
6	Select the **4 TPS Corrections** menu.
7	The **CONFIGURE TPS Corrections** panel appears. Set the following **AtmosPPM** parameters: Temperature: 12.0°C Atm Pressure: 1013.3 mbar Rel Humidity: 60% Atmospheric ppm.
8	Toggle with **PAGE (F6)** to the **GeoPPM** tab. Set the following GeoPPM parameters: Calc Scale: Manually Scale at C.M: 1.000000000000

	All other values must be set to zero.
9	Toggle with **PAGE (F6)** to the **Refraction** tab. Set the following Refraction parameters: Correction: Off
10	Confirm the settings with **CONT (F1)**.

Note: The ppm correction must be determined within GeoMoS.

Online-mode

Not available for Leica TPS1200 Instruments.

Auto-Start configuration

Follow these steps to configure Auto-Start.

Step	Action
1	Go to the **Main Menu**.
2	Select the **5 Config...** menu.
3	The **TPS1200 Configuration** panel appears.
4	Select the **3 General Settings...** menu.
5	The **CONFIGURE General Menu** panel appears.
6	Select the **6 Start Up & Power Down** menu.
7	The **CONFIGURE Start Up & Power Down** panel appears.
8	Set the **Start Screen** to **Main Menu**.
9	Confirm the setting with **CONT (F1)**.

Offsets

Follow these steps to configure Offsets.

Step	Action
1	Go to the **Main Menu**.
2	Select the **5 Config...** menu.
3	The **TPS1200 Configuration** panel appears.
4	Select the **1 Survey Settings...** menu.
5	The **CONFIGURE Survey Menu** panel appears.
6	Select the **4 Offsets** menu.
7	The **CONFIGURE Offsets** panel appears.
8	Set the **Offset Mode** to **Reset after REC**.
9	Set the **Offset Cross**, **Offset Length** and **Offset Height** to **0.000m**.
10	Confirm the setting with **CONT (F1)**.

Compensator and Hz-Correction

Follow these steps to configure Compensator and Hz-Correction.

Step	Action
1	Go to the **Main Menu**.
2	Select the **5 Config...** menu.
3	The **TPS1200 Configuration** panel appears.
4	Select the **2 Instrument Settings...** menu.
5	The **CONFIGURE Instrument Menu** panel appears.
6	Select the **5 Compensator** menu.
7	The **CONFIGURE Compensator** panel appears.
8	Set the **Compensator** to **On**.

9	Set the **Hz-Correction** to **On**.
10	Confirm the settings with **CONT (F1)**.

Optional: Instrument Protection with PIN

The onboard instrument settings can be protected by a **P**ersonal **I**dentification **N**umber. If the PIN protection is activated, the instrument will always prompt for a PIN code entry after starting up and before TPS1200+/TS30/TM30 Main Menu comes up. If a wrong PIN has been typed in five times, a **P**ersonal **U**nbloc**K**ing code is required. The PUK code can be found on the instrument delivery papers. The instrument protection with PIN/PUK does not embarrass the operation with GeoMoS.

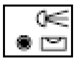
Follow these steps to configure the Instrument Protection with PIN:

Step	Action
1	Go to the **Main Menu**.
2	Select the **5 Config...** menu.
3	The **TPS1200 Configuration** panel appears.
4	Select the **3 General Settings...** menu.
5	The **CONFIGURE General Menu** panel appears.
6	Select the **6 Start Up & Power Down** menu.
7	The **CONFIGURE Start Up & Power Down** panel appears.
8	Toggle with **PAGE (F6)** to the **PIN code** tab.
9	Activates the PIN code protection: Set the **Use PIN** to **Yes**.
10	Type in a **New PIN** code. The PIN code must be a number with four to six digits.
11	Confirm the settings with **CONT (F1)**.

Leica TPS1100 instruments

Levelling-up with the electronic bubble

Follow these steps to level up with the electronic bubble.

Step	Action
1	Press on the total station **SHIFT** and then .
2	The longitudinal and transverse tilt of the instrument's vertical axis is displayed graphical and numerical.
3	Using the footscrews, the instrument can be levelled-up.

GSI communication settings

Follow these steps to configure the GSI communication settings.

Step	Action
1	Go to the **Main Menu: Programs**.
2	Select the **5 (Configuration)** button.
3	The **Main\ Configuration** panel appears.
4	Select **2 Communication Mode**.
5	The **Main\ Communication** panel appears.
6	Select **1 GSI parameters**.
7	The **Main\ GSI parameters** panel appears. Set the following GSI communication parameters: Baud rate Protocol: GSI Parity: No Terminator: CR/LF Data bits: 8 Stop bit: 1 **Note:** If using the switchbox it is essential to configure the baud rate to 9600.

6	Confirm the settings with **CONT**.

GeoCOM communication settings

Follow these steps to configure the GeoCOM communication settings.

Step	Action
1	Go to the **Main Menu: Programs**.
2	Select the **5 (Configuration)** button.
3	The **Main\ Configuration** panel appears.
4	Select **2 Communication Mode**.
5	The **Main\ Communication mode** panel appears**.**
6	Select **2 GeoCOM parameters**.
5	The **Main\ GSI parameters** panel appears. Set the following GeoCOM communication parameters: Baud rate Protocol: GeoCOM Parity: No Terminator: CR/LF Data bits: 8 Stop bits: 1 **Note:** If using the switchbox it is essential to configure the baud rate to 9600.
6	Confirm the settings with **CONT**.

Deactivate the Sleep Mode & Auto-Start configuration

Follow these steps to deactivate the Sleep Mode and to configure Auto-Start.

Step	Action
1	Go to the **Main Menu: Programs**.

2	Select the **5 (Configuration)**.
3	The **Main\ Configuration** panel appears.
4	Select the **1 Instrument config.**.
5	The **Main\ Instrument config.** panel appears.
6	Select **04 Power On, Power Off**.
7	The **Main\ Power On, Power Off** panel appears. Select Autoexec.: **Measure & Record**. and Power mode: Remains on. Select from the list box **Remains ON**.
8	Confirm the settings with **CONT**.

PPM settings

Follow these steps to configure the PPM settings.

Step	Action
1	Go to the **Main Menu: Programs**.
2	Select the **FNC** button.
3	The **FNC\ Function selection** panel appears.
4	Select the **1 PPM** button.
5	The **FNC\ PPM Atmospheric.** panel appears.
6	Select the **F2 (PPM)** button.
7	The **MEAS\ ATMOSPHERIC CORR.** panel appears. Set the following parameters: Atm.pressure : 1013.3mBar Temperature: 12.0°C ppm total: 0.0
8	Confirm the settings with **CONT**.

Note: The ppm correction must be determined within GeoMoS.

Additive Constant & EDM Mode

Follow these steps to configure the additive constant and the EDM Mode settings.

Step	Action
1	Go to the **Main Menu: Programs**.
2	Select the **5 (Configuration)** button.
3	The **Main\ Configuration** panel appears.
4	Select the **1 Instrument config.** button.
5	The **Main\ Instrument config.** panel appears.
6	Select the **03 Power EDM program selection** button.
7	The **Main\ EDM program selection** panel appears. Set the following parameters: Target Typ. : Reflector EDM Prog.: Standard Refl.list: Leica circ.prism Add. Const = 0.0mm
8	Confirm the settings with **CONT**.

Note: The additive constant is set in the GeoMoS Point Editor dialog for each point.

Online-mode

Do not use the GeoCOM On-Line mode for TPS1100 series. TPS1100 instruments must be always in the **Measure & Record** menu.

Offsets

Follow these steps to configure Offsets.

Step	Action
1	Go to the **Main Menu: Programs**.
2	Select the **FNC key**.
3	The **FNC\ Function** panel appears.
4	Select the **7 Increment & Offset** menu.
5	The **FNC\ Increment & Offset** panel appears.
6	Set the Offs. Cross, Offset Length and Offset Elev. to 0.000m
7	Confirm the setting with **CONT (F1)**.

Nivel210 and Nivel220

Each Nivel200 sensor must be configured individually. Connect each Nivel200 sensor separate to the **NivelTool**, because the software does not support multiple Nivel200 sensor communication. NivelTool is the office software including a series of functionality to support working with the Nivel200 sensor.

Follow these steps to configure a Nivel210 and Nivel220.

Step	Action
1	While starting up, NivelTool automatically searches for any connected Nivel200 sensor on all available COM ports with all baud rates.
2	The following Nivel200 sensor settings can be read and write: Specific Nivel200 sensor name Nivel200 sensor address Nivel200 sensor port (read only) Nivel200 baud rate Internal average number
3	Set a unique Nivel200 sensor address and required baud rate. The Nivel200 sensor address is N**x**. Valid addresses range: 0 to 9 and A to Z.

4	Store the settings with the **Write** button.

GPS1200

NMEA Out 1 - communication settings

Follow these steps to configure the NMEA Out 1 communication settings.

Step	Action
1	Go to the **Main Menu**.
2	Select the **5 Config...** menu.
3	The **GPS1200 Configuration** panel appears.
4	Select the **4 Interfaces...** menu.
5	The **CONFIGURE Interfaces** panel appears.
6	The **Interface NMEA Out 1** on **Port 1** with the **Device RS232** must be in use.
7	To set the communication parameters select on the **CONFIGURE Interfaces** panel the Interface **NMEA Out 1** and the **EDIT (F3)** button.
8	The **CONFIGURE NMEA Out 1** panel appears.
9	Select the **DEVCE (F5)** button.
10	The **CONFIGURE Devices** panel appears.
11	Select the **EDIT (F3)** button.
12	The **CONFIGURE Edit Device NMEA Out 1** panel appears. Set the required communication parameters: Baud rate Parity: None Data Bits: 8 Stop Bits: 1 Flow Control: None
13	Store the settings with the **STORE (F1)** button.

14	The **CONFIGURE Devices** panel appears again.
15	Select the **CONT (F1)** button.
16	The **CONFIGURE NMEA Out 1** panel appears again.
17	Select the **CONT (F1)** button.
18	The **CONFIGURE Interfaces** panel appears again.

NMEA Out 1 - messages settings

Follow these steps to configure the communication settings.

Step	Action
1	Go to the **Main Menu**.
2	Select the **5 Config...** menu.
3	The **GPS1200 Configuration** panel appears.
4	Select the **4 Interfaces...** menu.
5	The **CONFIGURE Interfaces** panel appears.
6	The **Interface NMEA Out 1** on **Port 1** with the **Device RS232** must be in use.
7	To set the communication parameters select on the **CONFIGURE Interfaces** panel the Interface **NMEA Out 1** and press the **EDIT (F3)** button.
8	The **CONFIGURE NMEA Out 1** panel appears.
9	Select the **MESGS (F2)** button.
10	The **CONFIGURE NMEA Messages** panel appears.
11	Select the **USE (F5)** button to activate the required message format. GeoMoS supports NMEA GGA and NMEA GNS.
12	Select the message format and press the **EDIT (F3)** button.
13	The **CONFIGURE NMEA Message to Send** panel appears.
14	Modify the settings if required.
15	Select the **CONT (F1)** button.

16	The **CONFIGURE NMEA Messages** panel appears again. Select the **CONT (F1)** button.
17	The **CONFIGURE NMEA Out 1** panel appears again. Select the **CONT (F1)** button.
18	The **CONFIGURE Interfaces** panel appears again.

Rover antenna settings

The rover can be connected via various communication possibilities (Bluetooth, cable). Contact the Leica Geosystems Dealer/Distributer in the country where you bought your product.

RTK corrections (reference antenna) settings

The reference can be connected via various communication possibilities (Bluetooth, cable). Contact the Leica Geosystems Dealer/Distributer in the country where you bought your product.

Leica Sprinter

Follow these steps to configure a Leica Sprinter.

Step	Action
1	Menu --> Settings --> RS232 --> Baud rate --> 9600, 8, 1, none
2	Menu --> Recording --> Ext
3	Using the footscrews, the instrument can be levelled-up.

Tour II: Connect a total station - Basic monitoring system

Objective

In this Quick Tour you will learn how to setup a single Leica total station for a simple monitoring system.

Procedure

Follow these steps to connect a total station for a basic monitoring system.

Step	Action
1	Start GeoMoS Monitor
2	Project Management
3	User level
4	Units
5	Coordinate system
6	Determine the control point coordinates
7	Sensor configuration and cable connection
8	Connect the total station to the GeoMoS Monitor application
9	Sensor Location and Orientation
10	Create Profiles
11	Create Limit Classes
12	Monitoring Points Create new points Learn points
13	Create Point Groups
14	Create a measurement cycle

15	Start the measurements

Step 1: Start GeoMoS Monitor

If the application GeoMoS Monitor is not running click on the desktop the Monitor shortcut  to start the Monitor application.

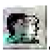
Step 2: Project Management

The database and settings are stored to specific projects. Follow these steps to create a new project.

Step	Action
1	Select from the menu **File**, **Project...** .
2	The **Projects** dialog will be displayed.
3	Create with the **New** button a project or use the default project 'GeoMoS Database'.
4	Select a project and press **Open** to activate it.
5	Confirm the entry with **OK**.

Step 3: User level

To setup the monitoring system it is necessary to have full access to all functionality. Follow these steps to configure the user level.

Step	Action
1	Select from the menu **File**, **User Level** or click on the toolbar **User Level button** .
2	The **User Level** dialog will be displayed.
3	Select the **Administrator** user level.

4	Confirm the entry with **OK**.

Step 4: Units

The units for the distance and angle values can be selected. Follow these steps to configure the units.

Step	Action
1	Select from the menu **Configuration**, **Customize...** or click the toolbar **Customize button** .
2	The **Customize** dialog will be displayed.
3	Change the settings as required.
4	Confirm the changes with the **OK** button.

Step 5: Coordinate system

The coordinate system for the project can be selected. Follow these steps to configure the coordinate system.

Step	Action
1	Select the menu **Configuration**, **Options...** or click the toolbar **Options button** .
2	The **Options** dialog window opens.
3	Change the settings as required.
4	Confirm the changes with the **OK** button.

Step 6: Determine the control point coordinates

The control point of a total station is a point in the **Point Editor** dialog and displayed with the symbol . The total station has to be connected in the **Sensor Manager** dialog or the **Sensor Setup** dialog with a point.

There are two possibilities to get the coordinates of the control point.

1. **Manual Coordinates**

   If you know the coordinates of the control point, you can enter them in the **Point Editor** dialog.

2. **Free Station with imported coordinates**

   If you do not know the coordinates of the control point, you can import known points, connect the sensor to the point in the sensor location dialog and make a Free Station for the control point.

To make it easier for the beginning, only the **Manual** coordinates are explained now. Please read in the help for further information for the import of points and free station.

Follow these steps to configure manual coordinates.

Step	Action
1	Select from the menu **Configuration**, **Point Editor...** or click the toolbar **Point Editor button** .
2	The **Point Editor** dialog will be displayed.
3	Press the **Insert Point** button to create a new point row.
4	Type in the unique point ID.
5	It is not necessary to select a profile from the list.
6	Type in the known coordinates for the control point.
7	Confirm the entry with **OK**.
8	There is now a point with the coordinates of the control point stored in the database. Each sensor has to be connected to a point to get coordinates.

In the next steps the control point will be assigned to the Total Station.

Step 7: Sensor configuration and cable connection

This is an optional step.

Follow these steps to confirm the sensor configuration and check if communication is functional.

If you are sure that the sensor configuration and communication is OK then you can skip this step.

Step	Action
1	Make sure the cable is connected from the PC to the Total Station and to the power supply.
2	Make sure the instrument communication settings are set correct.
3	Turn off the Total Station.
4	Proceed with the next step.

Step 8: Connect the total station to the GeoMoS Monitor application

Follow these steps to connect the total station to the GeoMoS Monitor application and to check the communication..

Step	Action
1	Select from the menu **Configuration**, **Sensor Manager...** or click the toolbar **Options button** .
2	The **Sensor Setup** dialog will be displayed.
3	Press the **Insert** button to insert a sensor.
4	A list box with all possible sensors appears. Select the type of sensor you wish to connect.
5	Activate the check box. This check box is used to activate/deactivate sensors.
6	Select the sensor and press the **Settings** button. Edit the sensor settings. Use for each sensor a unique name, description, control point and other sensor dependant settings. Press **OK** to confirm the settings.

7	Select the sensor and press the **Communication** button. Edit the communication options such as type, connection, baud rate, IP address and port. Press **OK** to confirm the settings.
8	Press the **Test** button to check the communication between GeoMoS Monitor and the connected sensor. A message box should confirm the successful initialization. **Note:** If you switched off the Total Station in Step 7, then the Total Station must turns on, but you receive the message "No data of the sensor is available. Please check if the sensor is properly connected." In this case press the **Test** button again. A message box confirms then the successful initialization. In case the message box returns an error please try to fix the communication between GeoMoS Monitor and the connected sensor first. Please refer to the Troubleshooting section, Sensor Communication.
9	Press **OK** to exit the **Sensor Setup** dialog.
10	The **Sensor Setup** dialog will be closed.

Step 9: Sensor Location and Orientation

All sensors connected in the **Sensor Setup** dialog to the monitoring system are listed in the **Sensor Location** dialog. Follow these steps to configure the instrument height and orientation.

There are two possibilities to get the orientation of the total station.

1. Orientation with "Know points"
2. Orientation with "Set manually"

To make it easier for the beginning, only the **Set manually** orientation is explained now.
Please read in the help for further information about Orientation.

Follow these steps to set manually the orientation.

Step	Action
1	Select from the menu **Configuration**, **Sensor Location Editor...** or click the toolbar **Sensor Location button** . The Sensor Location dialog appears.
2	Check the sensor is assigned to the correct Point ID. Modify the Point ID if required.
3	The total station is now connected to the point. The next step is the orientation.

4	Select the Sensor that needs to be orientated from the list and click the **Orientation** button. The **Orientation** assistant is displayed.
5	The total station control point and sensor type selected in the **Sensor Location** dialog will be displayed. These fields are not editable. Click the **Next >** button, to display the next page.
6	a. Aim manually the total station telescope to the defined null orientation to set manually the orientation value. b. Enter the instrument height if required and enter manually the GeoMoS orientation value = 0.000 c. Enter in the total station onboard program as Az value = 0.000. (Hz or Az depends on the used total station type)
7	Confirm the manually set orientation with the **Finish** button. The **Orientation** assistant will be closed and the data (orientation and instrument height) will be saved and used for further measurements and calculations.
8	Click the **OK** button to exit the **Sensor Location** dialog.
9	The coordinates and the orientation for the standpoint are set.

The points which should be monitored have to be entered, imported or learned to the system. This will be explained in the next steps.

Step 10: Create Profiles

Follow these steps to create Profiles.

Step	Action
1	Select from the menu **Configuration**, **Profile Editor...** or click the toolbar **Profiles button** .
2	The **Profile Editor** dialog will be displayed.
3	Click the **Insert** button to create a new profile row.
4	Enter the profile name and the azimuth.
5	Confirm the entry with **OK**.

In the next steps a point will be assigned to a selected profile which is used during the calculation of the displacement vector. Profiles can be assigned to points in the Point Editor dialog.

Step 11: Create Limit Classes

Follow these steps to create Limit Classes.

Step	Action
1	Select from the menu **Configuration**, **Limit Class Editor...** or click the toolbar symbol for **Limit Classes** .
2	The **Limit Classes** dialog will be displayed.
3	Create a new Limit Class.
4	Confirm the entry with **OK**.

In the next steps a point will be assigned to a selected limit class which is used during the messaging. Limit classes can be assigned to points in the Point Editor dialog.

Step 12: Monitoring Points

All points which should be monitored have to be created in the **Point Editor** dialog. The points will be connected with a profile and a limit class.

There are two possibilities to create point ID's.

1. Enter manually
2. Import

To make it easier for the beginning, only the **manually entered** points are explained now. Please read in the help for further information about Import.

Create new points

Follow these steps to create new points.

Step	Action
1	Select from the menu **Configuration**, **Point Editor...** or click the toolbar **Point Editor button** .
2	The **Point Editor** dialog will be displayed.
3	Click the **Insert Point** button to create a new point row.
4	Type in the unique point ID.
5	Select a **Profile** from the list.
6	Select a **Limit Class** from the list.
7	Enter the correct reflector height and the additive constant.
8	Then learn the new point as described below.

Learn points

Follow these steps to learn points.

Step	Action
1	Select the point ID you want to learn.
2	Aim manually the total station telescope to the selected prism.
3	Click the Learn button.
4	The instrument will execute the measurement and the coordinate information in the **Point Editor** dialog will be updated.
5	Repeat the **Create new points** and Step 1 to 4 for the additional points.
6	Click the **OK** button to exit the **Point Editor** dialog and to confirm the entries.

Step 13: Create Point Groups

The created points should be assigned to a point group. The creation of point groups allows points to be easily measured in scheduled cycles. Point groups are also used to view individual points in the **Analyzer** application.

Follow these steps to create Point Groups.

Step	Action
1	Select from the menu **Configuration**, **Point Group Editor...** or click the toolbar **Point Group button** .
2	The **Point Group Editor** dialog will be displayed.
3	Click the **Insert** button to create a new point group row.
4	Enter the **Name** of the point group.
5	Select the **Type** 'Normal' from the list.
6	Set the **Search window** to 0.5. The search window sets the range where the instrument can search the prism. The range depends on the measured distance.
7	Press the **Properties** button to define for each point group settings, if necessary.
8	Define the contents of the point group by "dragging and dropping" selected points and/or profiles from the respective lists of points and profile to the point group list.
9	Confirm the **Point Group** dialog with **OK**.
10	Select in the Monitoring System / Point Group Toolbar the previously created point groups.
11	Press the button **Measure Point Group** to check the total station measures all assigned points correct.
12	Optimise the measurement order of the points within the point groups, if necessary.

Step 14: Create a measurement cycle

The created point groups can be added to the automatic measurement cycle.

Follow these steps to create a measurement cycle.

Step	Action
1	Select from the menu **Configuration**, **Measurement Cycle Editor...** or click the toolbar **Measurement Cycles button** .
2	The **Measurement Cycle Editor** dialog will be displayed.
3	Click the **Insert** button to create a new measurement row.
4	Select in the column **TPS Sensor** your previously configured total station.
5	Select in the column **Point Group** your previously defined point group from the list.
6	Enter the **Start time** '00:00:00'.
7	Set **Continuous** to 'No'.
8	Set the **Interval** time.
9	Enter the **End time** '23:59:59'.
10	Select Face I for **Telescope position**.
11	Click the **OK** button to exit this dialog.

Step 15: Start the measurements

Follow these steps to start the measurements.

Step	Action
1	Select from the menu **Measurement**, **Start automatic, or click** the toolbar button **Start** to start the measurement cycle. The instrument should start to measure.
2	Select from the menu **Measurement**, **Pause automatic**, **or click** the toolbar button **Pause** to pause the measurement cycle.
3	Select from the menu **Measurement**, **Stop automatic**, **or click** the toolbar button

	Stop to stop the measurement cycle.

Remarks:

The measurements and calculations use the current computer time. Do not change the system time of your computer due to summer/winter time. It can effect the computations and the storage of the data in the database. If the computer time has to be changed for any reason GeoMoS should be stopped and the application Monitor restarted.

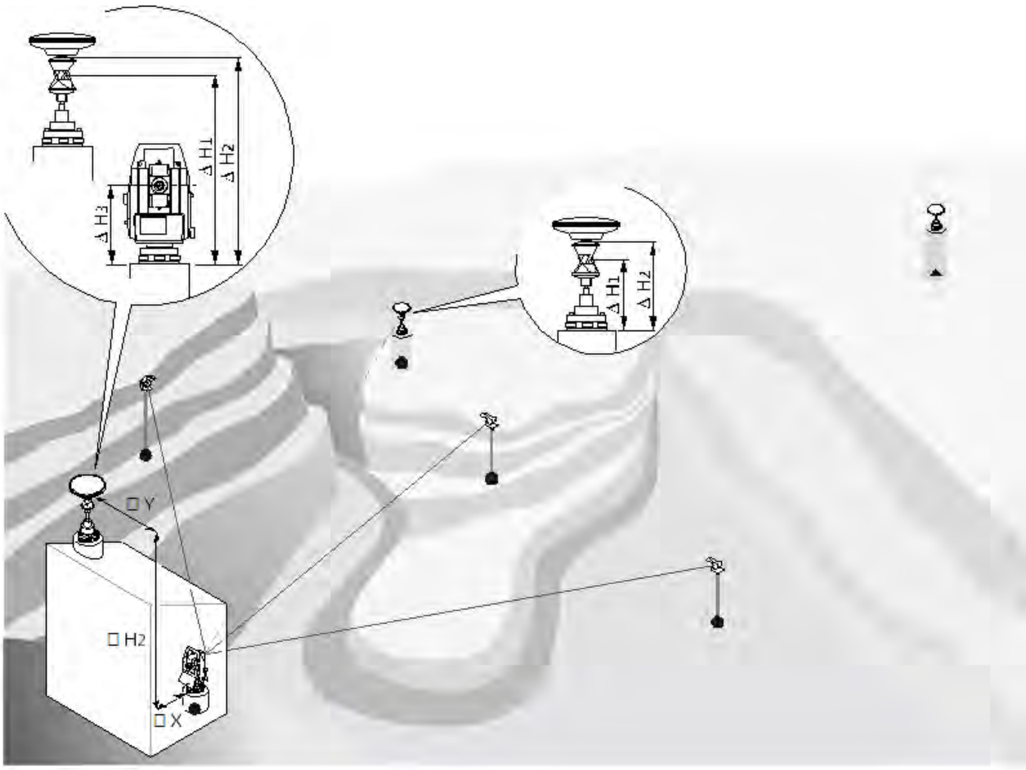
Note:

The above description guided you through the creation process by describing the minimum settings only. For more detailed information please refer to the related sections in the online help.

Tour III: Setup a total station with a co-located GNSS sensor

Objective

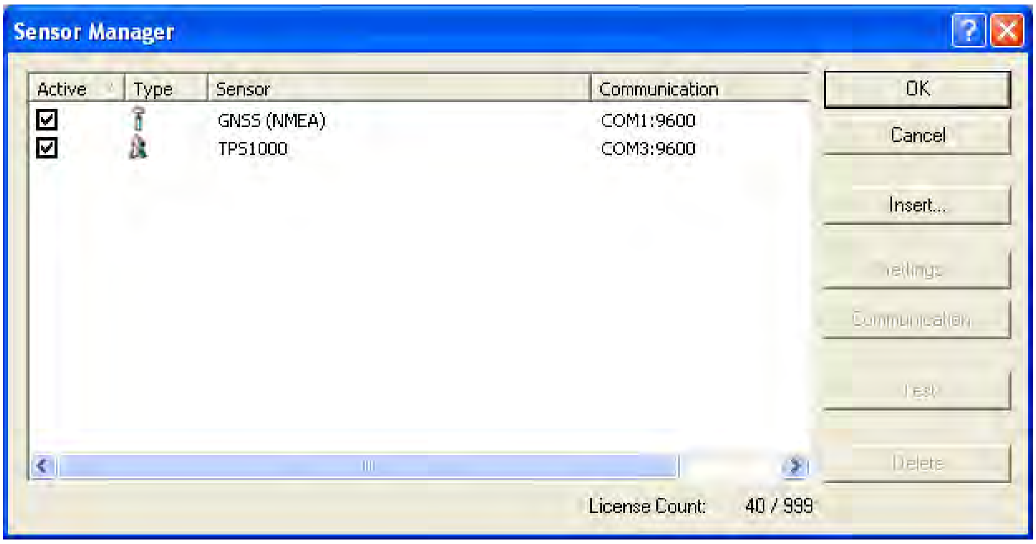
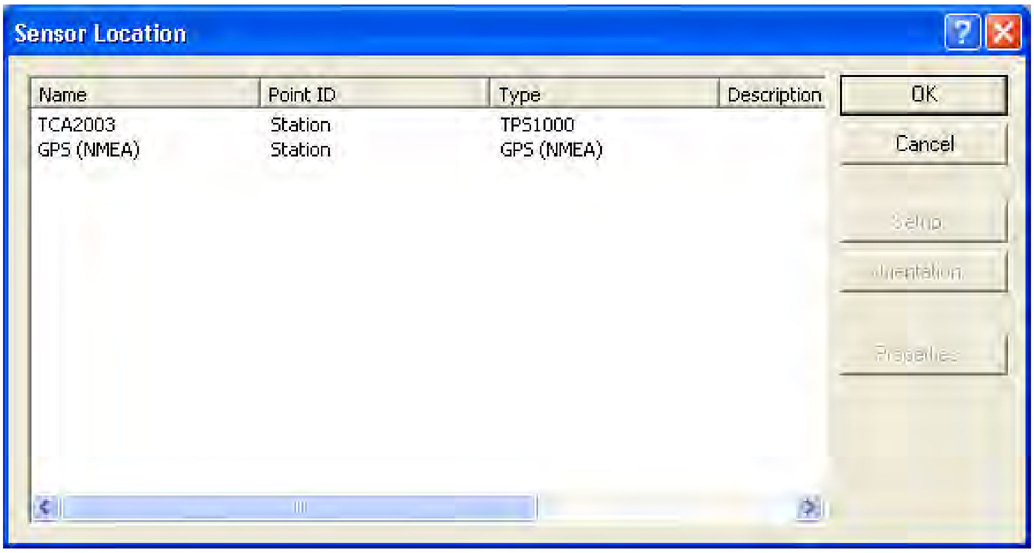
In this Quick Tour you will learn how to setup a Leica total station with a co-located GNSS sensor. The Total Station coordinates are updated with GNSS observations.

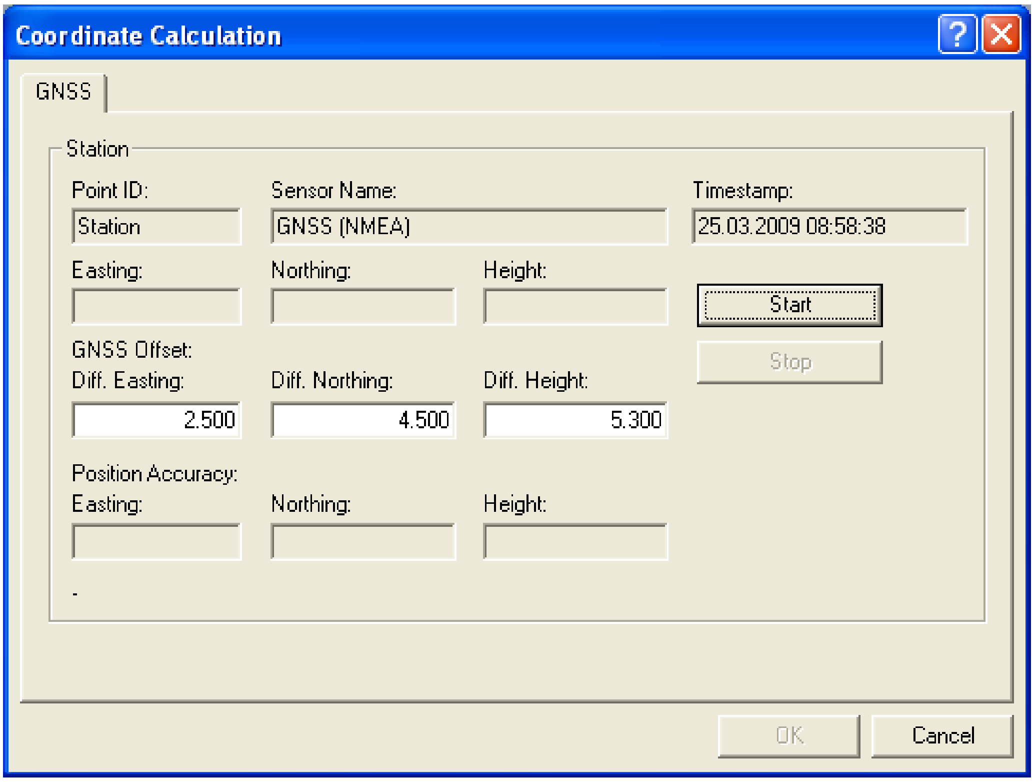


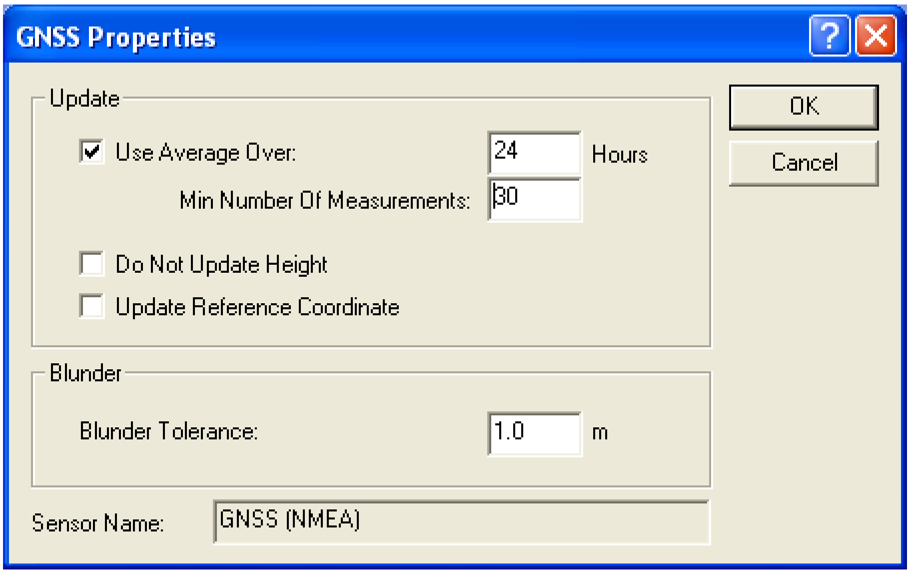
Procedure

Follow these steps to setup a total station with a co-located GNSS sensor.

Step	Action
1	Configure a GNSS sensor with 1Hz NMEA GGA output. Only a quality level of 4 (ambiguity fixed phase position) will be used for monitoring.
2	To define a coordinate system in the Coordinate System Manager select the menu **Configuration, Options...** or click the toolbar **Options button** .
3	The **Options** dialog is displayed. Either define your own coordinate system or choose a existing coordinate system from the list box. The set transformation is used to transform

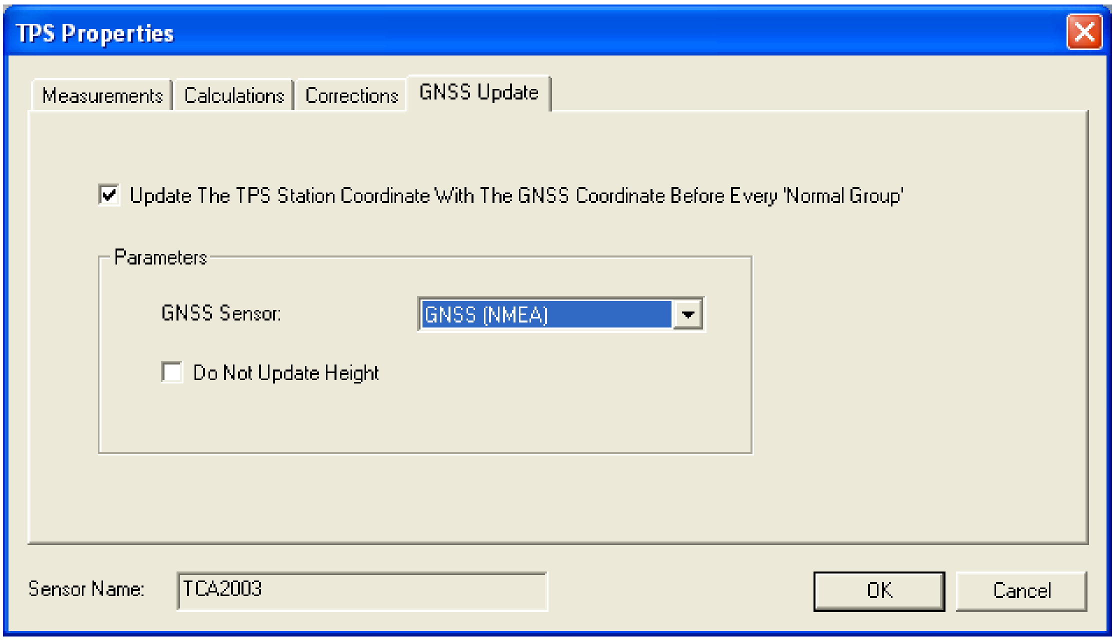
	coordinates from *WGS1984* to a *Local* system.
4	To connect the GNSS sensor and the total station select the menu **Configuration, Sensor Manager...** or click the toolbar **Sensor Manager button** .
5	The [Sensor Manager]() dialog is displayed.  Insert the total station and the GNSS sensor and confirm the entries with **OK**.
6	To assign the connected GNSS receiver to the total station sensor select the menu **Configuration, Sensor Location...** or click the toolbar **Sensor Location button** .
7	The [Sensor Location]() dialog is displayed.  Select the **identical control point** for the GNSS sensor and the Total Station.
8	Select the **Setup...** button in the **Sensor Location** dialog for the GNSS sensor.

9	The Coordinate Calculation dialog is displayed. Enter the coordinate offset of the GNSS Sensor in the **GNSS-Offset** fields as Easting Difference, Northing Difference and Height Difference. The offset indicates the eccentricity of the GNSS antenna to the point. Use the **Start** and **Stop** button to record and average **GNSS** coordinates and the **standard deviation** of the **coordinates**.  Confirm the entries with **OK**.
10	Select the **Properties...** button in the **Sensor Location** dialog for the GNSS sensor.
11	The **GNSS Properties** dialog is displayed. Activate the check box "Use Average Over and define an average", the "minimal number of measurements" and a "blunder tolerance". These values are important to increase the GNSS data accuracy for the purpose of updating the total station.

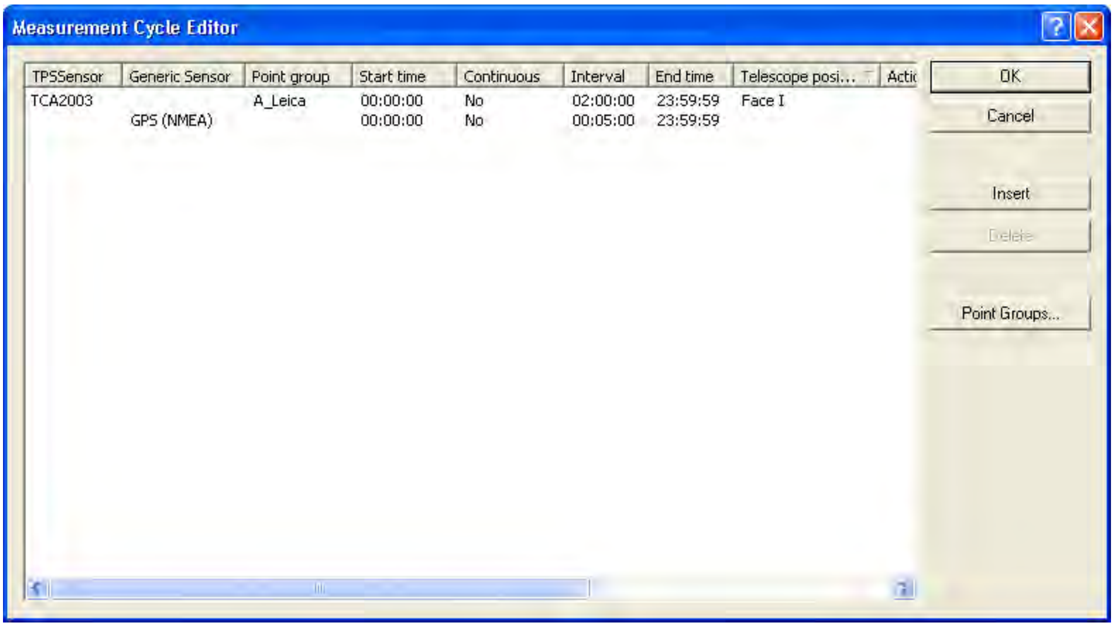
<table>
<tr><td></td><td>


Confirm the entries with OK.</td></tr>
<tr><td>12</td><td>Select the Properties... button in the Sensor Location dialog for the total station.</td></tr>
<tr><td>13</td><td>The TPS Properties dialog is displayed. Select GNSS Update tab.

Activate the check box "Update the TPS Station With GNSS Before Measuring A 'Normal Group'" and select the correct GNSS sensor.



Confirm the entries with OK.</td></tr>
<tr><td>14</td><td>To define measurements for the GNSS Update select the menu Configuration, Measurement Cycle Editor... or click the toolbar Sensor Manager button .</td></tr>
<tr><td>15</td><td>The Measurement Cycle Editor is displayed.</td></tr>
</table>

	Define e.g. for the GNSS sensor an interval of 5 minutes. 
16	To check the measurements select the **Last Action** view.

Note:

The above description guided you through the creation process by describing the minimum settings only.

Tour IV: Setup a RT Positioning Product

Objective

In this Quick Tour you will learn how to configure a RT Positioning Product in GNSS Spider and connect it in the GeoMoS Sensor Manager.

Procedure

Follow these steps to setup a RT Positioning Product.

Step 1: Configure RT Positioning Products in GNSS Spider

Follow these steps to configure RT Positioning Product in GNSS Spider.

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>Open the local site server. Switch with the Tabbed-View to the Site tab. Start the reference and monitoring sites.</td></tr>
<tr><td>2</td><td>Switch with the Tabbed-View to the RT Positioning tab. Click into the RT Positioning Products window and select New&ldots; from the context menu. Now the RT Product dialog appears. Create a new RT Positioning Product with the following settings:</td></tr>
<tr><td>3</td><td>Set "Send positions to" as GeoMoS.</td></tr>
<tr><td>4</td><td>Set the "Initialisation" as Quasi Static.</td></tr>
<tr><td>5</td><td>Set the "Data Rate" as 1Hz.</td></tr>
<tr><td>6</td><td>Ensure sites are connected, started, that the RT Positioning Products are active and that RTK solutions are available.
<table>
<tr><th></th><th></th><th>CQ [m]</th><th>GDOP</th><th>Sats</th><th>Last Change</th><th>X</th><th>Y</th><th>Z</th><th>Distance</th><th>Product Name</th><th>Site code</th><th>Ref-Site code</th><th>Send to</th><th>Proces...</th><th>Initialisation</th><th>Cor</th></tr>
<tr><td></td><td></td><td>0.051</td><td>3.1</td><td>6</td><td>20.12.2005 13:21:41</td><td>4278707.8517</td><td>722199.2679</td><td>4659686.2355</td><td>19.934 km</td><td>Heerbrugg-Feldkirch_GGA</td><td>FELD</td><td>HEER</td><td>TCP/IP</td><td>L1/L2</td><td>Quasi-Static</td><td>ahe</td></tr>
<tr><td></td><td></td><td>0.016</td><td>3.9</td><td>7</td><td>20.12.2005 13:21:40</td><td>4278707.8218</td><td>722199.2930</td><td>4659686.2657</td><td>7.825 km</td><td>Feldkirch-Ruthi_GGA</td><td>FELD</td><td>RUTH</td><td>TCP/IP</td><td>L1/L2</td><td>Quasi-Static</td><td>ahe</td></tr>
<tr><td></td><td></td><td>0.042</td><td>3.9</td><td>6</td><td>20.12.2005 13:21:41</td><td>4264776.1027</td><td>701896.3450</td><td>4675676.7399</td><td>30.234 km</td><td>St Gallen-Lindau_GGA</td><td>STGA</td><td>LIND</td><td>TCP/IP</td><td>L1/L2</td><td>Quasi-Static</td><td>ahe</td></tr>
</table>

Note:
You can also set the Send To to TCP/IP and the format as GGA or GNS. GeoMoS can then connect using the sensor type "GPS NMEA (TCP/IP)". Note that this requires 10 Sensor Licenses in the sensor manager per product where as the "GNSS Spider" sensor uses only 10 Sensor Licenses for all products.</td></tr>
</table>

Step 2: Connect GNSS Spider RT Positioning Products in the GeoMoS Sensor Manager

Follow these steps to connect GNSS Spider RT Positioning Products in the GeoMoS Sensor Manager.

Step	Action
1	Create a coordinate system to convert from WGS84 to the local system.
2	Add a **sensor** of type "GNSS Spider RT Products" to the **Sensor Manager**.
3	Set the **IP address** or **computer name** of the GNSS Spider site server and the site server password.
4	Open the RT Positioning Products dialog. All the RT Positioning Products configured for GeoMoS will be shown and can be activated or deactivated.
5	Close the Sensor Manager dialog with OK
6	Add the RT Positioning Product in the Measurement Cycle Editor.
7	Select the menu **Measurement**, **Start automatic, or click** the toolbar **Start button** .
8	Check with the Last Actions, Messages and Chart tab the results of the RT Positioning Product.

Tour V: Basic data analysis

Objective

In this Quick Tour you will learn some basic methods to analyse the data of your monitoring system.

Procedure

Follow these steps to perform basic data analysis.

Step	Action
1	Start GeoMoS Analyzer
2	Project Management
3	User level
4	Units
5	Period of Time
6	Tree view
7	Basic Graphics Timeline (Longitudinal Displacement) Velocity Vector
8	Advanced Graphics
9	Congratulations (Finish)

Step 1: Start GeoMoS Analyzer

If the application GeoMoS Analyzer is not running click on the desktop the Analyzer symbol to start the application Analyzer.

The GeoMoS Analyzer application will be started.

Step 2: Project Management

The database and settings are stored to specific projects. Follow these steps to configure the project management.

Step	Action
1	Select from the menu **File**, Project... .
2	The Projects dialog will be displayed.
3	Create with the **New** button a project or use the default project 'GeoMoS Database'.
4	Confirm the entry with **OK**.

Step 3: User level

Follow these steps to configure the user level.

Step	Action
1	Select from the menu **File**, User Level or click on the toolbar button **User Level** .
2	The **User Level** dialog will be displayed.
3	Select the **Administrator** user level.
4	Confirm the entry with **OK**.

Step 4: Units

The units for the distance and angle values can be selected. Follow these steps to configure the units.

Step	Action
1	Select from the menu **Configuration**, **Customize...** or click the toolbar button **Customize** .
2	The **Customize** dialog will be displayed.

3	Change the settings as required.
4	Confirm the changes with the **OK** button.

Step 5: Period of Time

Follow these steps to configure the Period of Time.

Step	Action
1	Select from the menu **View**, **Time Period...** or press the toolbar button **Time Period** .
2	The **Viewer** dialog will be displayed.
3	Set the **start** date just before you started the measurements.
4	Click the check box **End time is always current time** to set the automatic end time.
5	Confirm the changes with the **OK** button.

Step 6: Tree view

The tree view lists all points, profiles, point groups you created and the sensors stored in the database. Check the point group you created previously. These points will be shown in the graph.

Step 7: Basic Graphics

The application Analyzer shows different graphs. Displacements over time, velocity and vectors can be visualized.

Timeline (Longitudinal Displacement)

Follow these step to configure the timeline (Longitudinal Displacement) graphics.

Step	Action
1	Select from the menu **Configuration**, **Graphic Options** or press the button **Options**

	.
2	The **Options** dialog will be displayed.
3	Select the first page called **Longitudinal Displacement** in the **Options** dialog.
4	To see the timeline without filter check **Raw data**.
5	Select the point displacement **relative to 1st measurement in time period**.
6	Click the button **OK** to exit this dialog.
7	Select in the tabbed-view the first tab called **Longitudinal Displacement**.
8	Select from the menu **View**, **Refresh** or **F5** or the **Refresh button** to query the data out of the database.
9	The **longitudinal displacement** timeline graph will be displayed.

Velocity

To set Velocity options and display Velocity graphs, refer to the related sections in the online help.

Vector

Follow these steps to configure the Vector graphics.

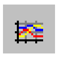
Step	Action
1	Select from the menu **Configuration**, **Graphic Options** or press the button **Options** .
2	The **Options** dialog will be displayed.
3	Select the page called **Vector** in the **Options** dialog.
4	Enter the **displacement range** depending on the measured movements of your points.
5	Select the point displacement **relative to 1st measurement in time period**.

6	Click the button **OK** to exit this dialog.
7	Select the third page called **Vector**.
8	Select from the menu **View**, **Refresh** or **F5** or the **Refresh button**  to query the data out of the database.
9	The **vector** will be displayed.

Step 8: Advanced Graphics

The **Multiple Graphs** tab is a powerful graphing tool to display multiple series in a single graphic.

Follow these steps to configure advanced graphics.

Step	Action
1	Select in the tabbed view the **Multiple Graphs** tab.
2	Select from the Graphic toolbar the  button or press the right mouse button and select from the context menu the entry **Series**.
3	The **Series** dialog with the **Standard series** will be displayed.
4	Select in the first column the check box to activate and display the standard series. **Note:** Only two different units can be displayed at the same time on the **Multiple Graphs** tab.
5	The order of the **Standard Series** dialog decides which scale is displayed on the left hand side and right hand side. The order of the standard series can be changed with the **Move Up** and **Move Down** buttons.
6	The abbreviation of the **Standard Series** dialog can be changed to the customer needs. The abbreviation is used in combination with the point name in the point legend.
7	In addition to standard series it is possible to also display Velocity series.. Select the tab **Velocity** in the series dialog.
8	The **Series** dialog with the Velocity series will be displayed.

9	To set and display **Velocity Series**, refer to the related sections in the online help.
10	Click the button **OK** to exit this dialog.
11	Select from the menu **Configuration**, **Graphic Options** or press the button **Options** .
12	The **Options** dialog will be displayed.
13	Select the page called **Multiple Graphs Unit 1 or Multiple Graphs Unit 2** in the **Options** dialog.
14	To see the timeline without filter check **Raw data**.
15	Select the point displacement **relative to 1st measurement in time period**.
16	Click the button **OK** to exit this dialog.
17	Select from the menu **View**, **Refresh** or **F5** or the **Refresh button** to query the data out of the database.
18	The **multiple graphs** timeline will be displayed.

Remarks:

The measurements and calculations use the current computer time. Do not change the system time of your computer due to summer/winter time. It can effect the computations and the storage of the data in the database. If the computer time has to be changed for any reason GeoMoS should be stopped.

Congratulations

You have now successfully completed this Quick Tour, and are now familiar with the basic analyzing methods of monitoring system using the GeoMoS Analyzer!

To create your own color palette, set daily averages and add comments with the GeoMoS Analyzer, please refer to the related sections in the online help.

Tour VI: Re-orientate a total station

Objective

In this Quick Tour you will learn how to reset the total station orientation using the **Sensor Location** dialog. If the total station has been used manually, moved or replaced the total station orientation must be reset.

Procedure

The information in this steps describes how to determine the orientation with Method A "Known points" (here: instrument control point and target point).

Step	Action
1	Select the menu **Configuration**, **Sensor Location...** or press the toolbar **Sensor Location button** . The **Sensor Location** dialog appears.
2	Select the Sensor that needs to be orientated from the list and click the **Orientation** button. The **Orientation** assistant is displayed.
3	The total station control point and sensor type selected in the Sensor Location dialog will be displayed. These fields are not editable. Click the **Next >** button, to display the next page.
4	Enter the instrument height if required. Do not modify the orientation value, because this value is only used for the orientation Method B "set manually". Click the **Next >** button, to display the next page.
5	Select the target point to measure for the orientation calculation. Click the **Next >** button to display the next page.
6	Aim manually the total station telescope to the selected target point selected in Step 5
7	a. Select **Use ATR** and press the **Measure** button to take the measurement to a known point (prism is necessary). GeoMoS Monitor reads the angles and the distance to the known target point. The orientation will be calculated and displayed in the dialog OR

	b. Do not select Use ATR and press the **Measure** button to take the measurement to a known point. GeoMoS Monitor reads only the angles from the total station pointing to the known target point. The orientation will be calculated and displayed in the dialog
8	Confirm the calculated orientation with the **Finish** button. The **Orientation** assistant will be closed and the data (orientation and instrument height) will be saved and used for further measurements and calculations.

Hint: Check for example with a manual point group measurements if the orientation was successful.

Related topics

Orientation Wizard dialog

Tour VII: Setup and connect a Campbell datalogger

Note: Sorry, this section is currently under construction. For more detailed information please contact your Leica representative.

Objective

In this Quick Tour you will learn some basic steps to connect the Campbell Scientific datalogger to the Leica GeoMoS Monitor.

Procedure

Follow these steps to setup and connect a Campbell datalogger.

Step	Action
1	Install PC200W Datalogger Support Software
2	Set up communication between datalogger and computer
3	Develop program for the datalogger
4	Connect with Leica GeoMoS

Step 1: Install PC200W Datalogger Support Software

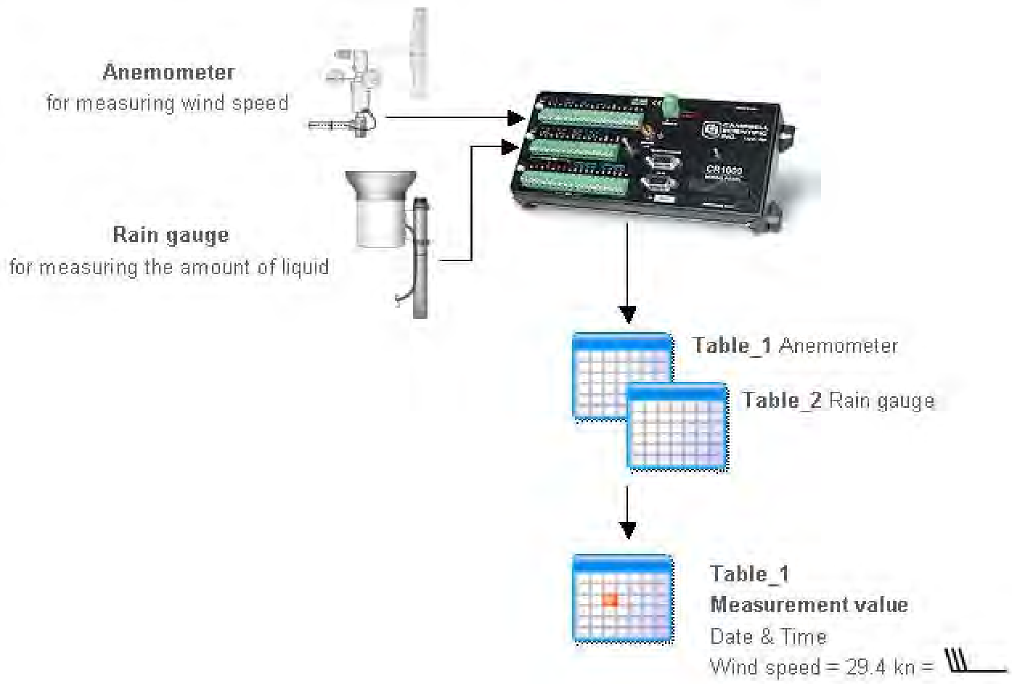
The Campbell datalogger requires a very small and simple onboard program for retrieving and storing geotechnical sensor data. We recommend using the free of charge PC200W Datalogger Support Software. This is a simplified windows-based software with quick start tutorials that help the user through the complete process. Leica support specialists will help you providing the optimal datalogger program.

Step 2: Set up communication between datalogger and computer

To upload the program for the Campbell datalogger with the PC200W Datalogger Support Software it is required that you are connected directly via a serial COM port.

Step 3: Develop program for the datalogger

The Campbell datalogger records data over time from connected geotechnical sensors outputs measurement values to Leica GeoMoS.



- Each geotechnical sensor connected to the Campbell datalogger records the data into a table.
- Each measurement value is recorded to a field in the table.

The Campbell datalogger program needs to be written to meet these simple principle.

1. Start the PC200W Datalogger Support Software.
2. Follow the wizard or click the Add button.
3. ...

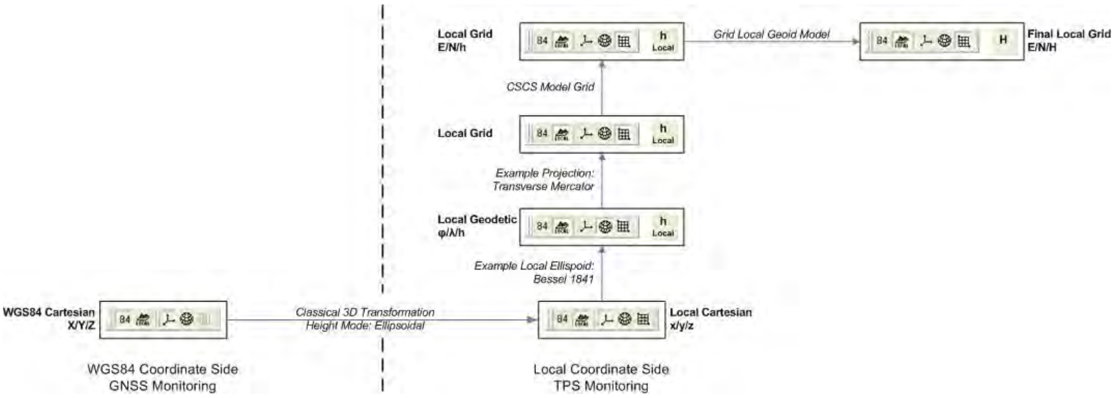
Step 4: Connect with Leica GeoMoS

Read in the Sensor Manager how to connect the Campbell datalogger and geotechnical sensor with GeoMoS.

Tour VIII: Configure a coordinate system

Objective

In this Quick Tour you will learn how to setup an example Coordinate System for the use of combined total station and GNSS monitoring.



Procedure

Follow these steps to configure a Coordinate System.

Step	Action
1	Open the Coordinate System Manager
2	Create a new Transformation
3	Create a new Ellipsoid
4	Create a new Projection
5	If required import a new geoid model
6	If required import a new CSCS Model
7	Configure a coordinate system

Step 1: Open the Coordinate System Manager

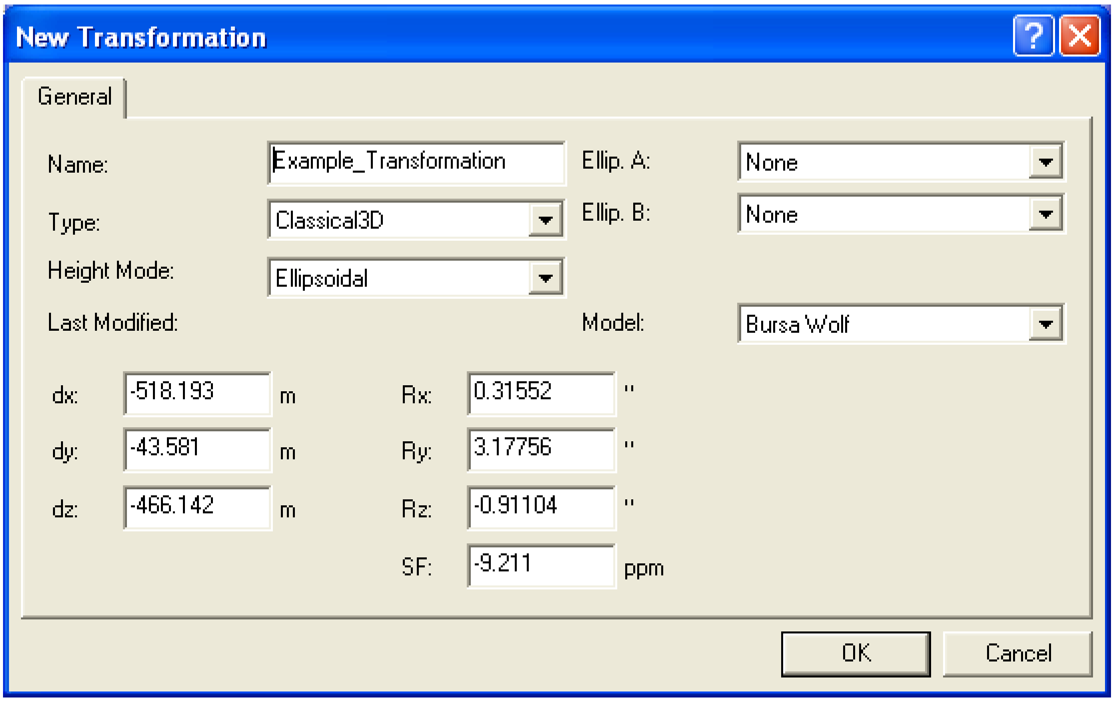
Follow these steps to open the Coordinate System Manager.

Step	Action
1	Select from the menu **Configuration**, **Options...** .
2	The **Options** dialog will be displayed.
3	Open with the **Properties...** button the Coordinate System Manager.
4	Continue to Step 2: Add a new Transformation.

Step 2: Add a new Transformation

Follow these steps to create a new Transformation.

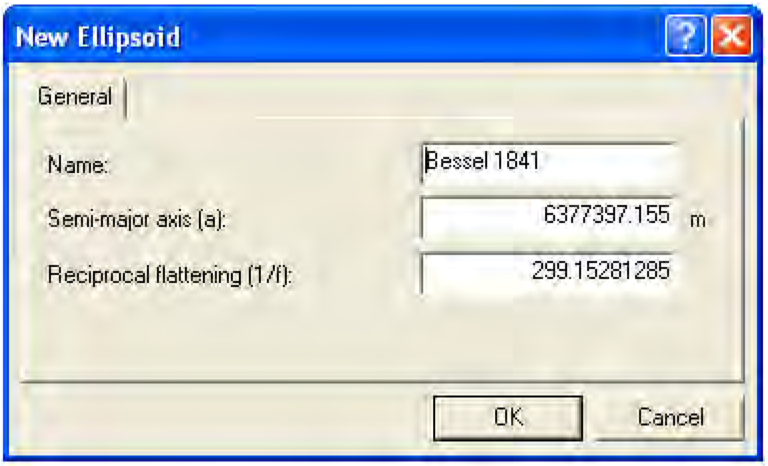
Step	Action
1	Right-click on **Transformations** in the Tree-View and select **New**.
2	The **New Transformation** dialog appears.
3	▪ Enter the **Name** of the Transformation. ▪ Select the **Type** of the Transformation. **Note**: Only the types Classical 2D and Classical 3D may be added manually. Other Transformation types can only be added (determined) using the **Leica LGO Datum/Map** tool. ▪ Select the **Height Mode** of the Transformation. Choose between Ellipsoidal or Orthometric. **Note:** The Height Mode may only be selected for Classical 3D Transformations. It can also be determined using the **Leica LGO Datum/Map** tool. ▪ Enter the necessary **parameters** of the selected Transformation type. **Note**: The fields **Ellip. A** and **Ellip. B** are for information purpose only.

	
4	Press **OK** to confirm or **Cancel** to abort the function.
5	Continue to Step 3: Add a new Ellipsoid.

Step 3: Add a new Ellipsoid

Follow these steps to create a new Ellipsoid.

Step	Action
1	Right-click on **Ellipsoids** in the Tree-View and select **New**.
2	The **New Ellipsoid** dialog appears.
3	▪ Enter the **Name** of the Ellipsoid ▪ Enter the **Semi-major axis (a)** of the Ellipsoid ▪ Enter the **Reciprocal flattening (1/f)** of the Ellipsoid

	
4	Press **OK** to confirm or **Cancel** to abort the function.
5	Continue to Step 4: Add a new Projection.

Step 4: Add a new Projection

Follow these steps to create a new Projection.

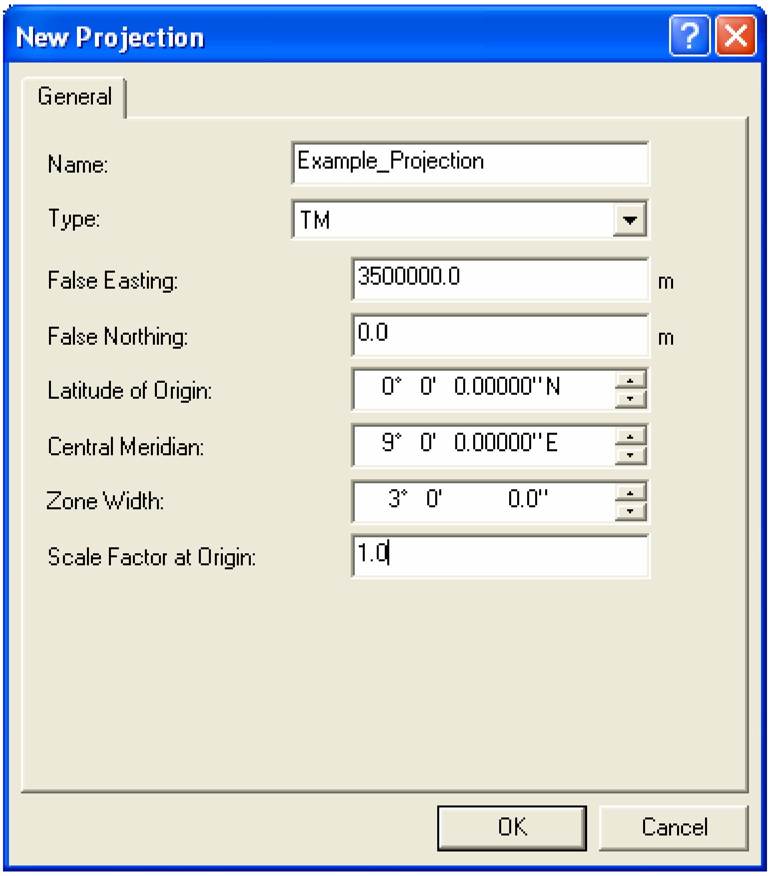
Step	Action
1	Right-click on **Projections** in the Tree-View and select **New**.
2	The **New Projetion** dialog appears.

3	▪ Enter **Name** of Projection. It is often useful to give any Projection set a meaningful name that identifies the area in which the Projection is applicable. For example: UTM, Zone 5, hemisphere north (UTM 5 North).
	▪ Select **Type** of Projection:
	    ▪ Mercator
	    ▪ Transverse Mercator (TM)
	    ▪ Oblique Mercator
	    ▪ Universal Transverse Mercator (UTM)
	    ▪ Cassini Soldner
	    ▪ Lambert - one Standard Parallel
	    ▪ Lambert - two Standard Parallels
	    ▪ Polar Stereographic

- Dou ble Stereographic
- Rectified Skewed Orthomorphic or
- User defined

- Enter the necessary **parameters** of the selected Projection.

  Note: It is not possible to use State Plane Zones directly. To use State Plane Zones in GeoMoS they must be converted in **Projections**.

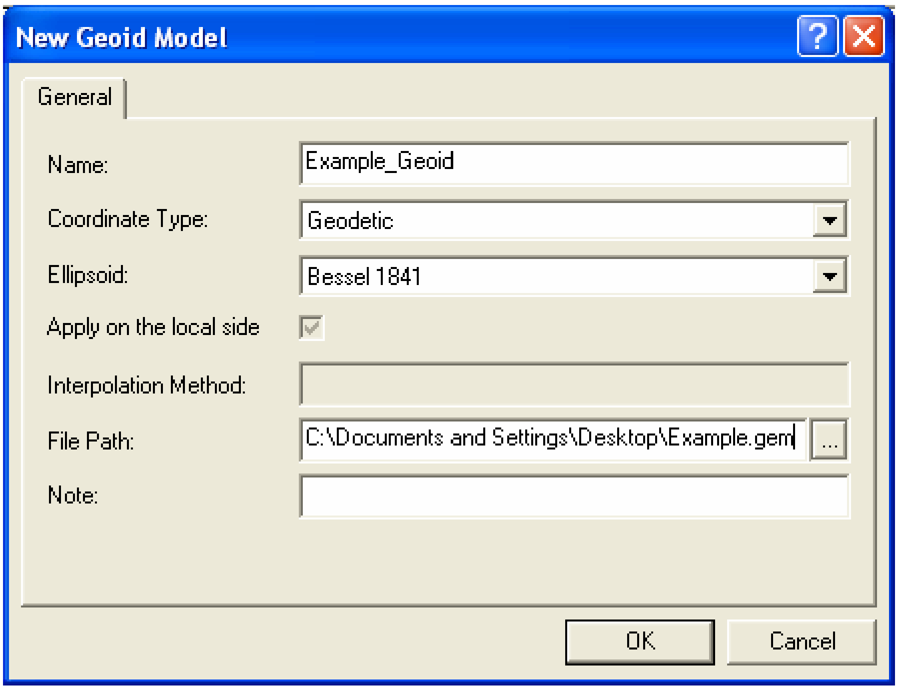


4	Press **OK** to accept entered values or **Cancel** to abort the function.
5	Continue to Step 5: Add a new Geoid Model.

Step 5: If required add a new Geoid Model

Follow these steps to import a new Geoid Model.

Note: In order to import a new Geoid Model into the Coordinate System Management it must be available in the Windows directory. For more details refer to Geoid Models: How to write your own Geoid Model and Compute Geoid Separations with Leica LGO.

Step	Action
1	Right-click on **Geoids** in the Tree-View and select **New**.
2	The **New Geoid Model** dialog appears.
3	▪ Enter the **Name** for the new Geoid Model. ▪ Select the **Coordinate Type** (Geodetic or Grid) that the Geoid Model shall be defined for. (For coordinate type Geodetic with height scaling see: Geoid models with height scaling.) If the Geoid Model is defined using a GEM file, then the coordinate type is defined with the Geoid Model file. ▪ Select the reference **Ellipsoid** which the model shall refer to. If the Geoid Model is defined using a GEM file, then the Ellipsoid is defined with the Geoid Model file. **Note**: For the Geodetic Geoid Models which refer to the WGS84 Ellipsoid you may select ☑ **Apply on the local side**. The geoid separations will then be applied after the Transformation, i.e. to the local Ellipsoidal heights. ▪ Enter the **path** and name of the Geoid Model file. You can either select an executable file (*.exe) or a Geoid Model field file (*.gem). To select from the browser press [...]. ▪ Enter an optional **Note** to describe the Geoid Model. 

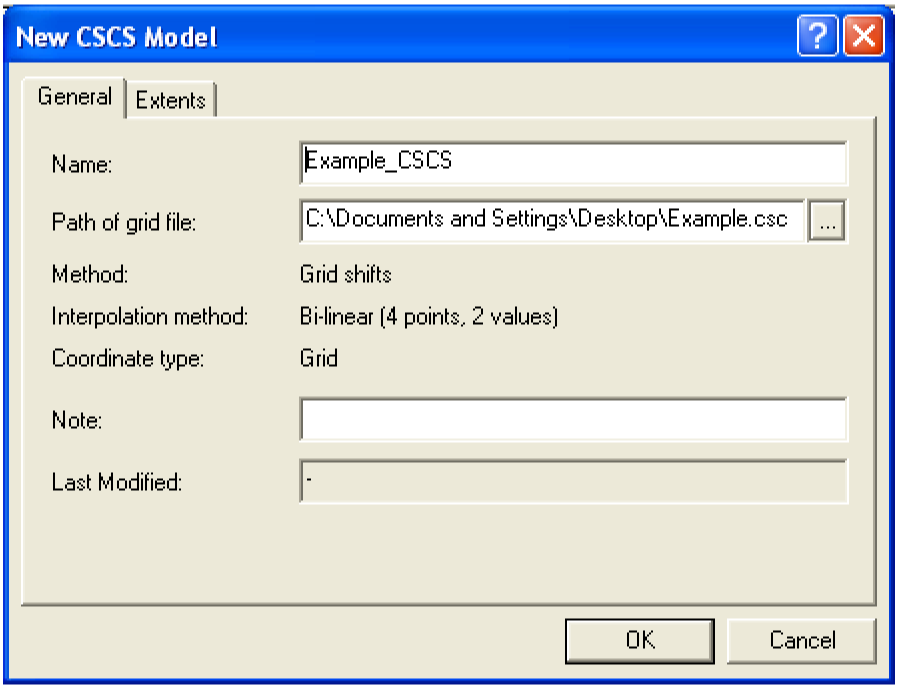
4	Press **OK** to accept entered values or **Cancel** to abort the function.
5	Continue to Step 6: Add a new CSCS model.

Step 6: If required add a new CSCS Model

Follow these steps to create a new CSCS Model.

Note: In order to import a new CSCS Model into the Coordinate System Management it must be available in the Windows directory. For more details refer to CSCS Models and Other CSCS Models.

Step	Action
1	Right-click on **CSCS Models** in the Tree-View and select **New**.
2	The **New CSCS Models** dialog appears.
3	▪ Enter the **Name** for the new CSCS Model. ▪ Enter a path and name of the grid file or press  to select from the browser. ▪ The Method, Interpolation method and Coordinate type will be displayed if a valid CSCS file has been selected. ▪ Enter an optional Note to describe the CSCS Model.

	
4	Press **OK** to accept entered values or **Cancel** to abort the function.
5	Continue to Step 7: Configure a Coordinate System

Step 7: Configure a Coordinate System

Follow these steps to configure a Coordinate System.

Step	Action
1	Right-click on **Coordinate Systems** in the Tree-View and select **New**.
2	The **New Coordinate System** dialog appears.
3	▪ Enter the **Name** of the Coordinate System. ▪ Select a **Transformation** from the list. Transformations may be calculated using Leica LGO Datum/Map or in the case of a Classical 2D and 3D, manually entered. ▪ If you have selected a Transformation that was previously calculated using Leica LGO Datum/Map you may choose how to distribute the **Residuals**. The distribution weighting may be in relation to the distances between the point to be transformed and the control points or by using a Multi-quadratic interpolation approach. No distribution will be selected by default.

<table>
<tr><td></td><td>

▪ Select an **Ellipsoid** for the Local system (System B) from the list.

Note: An Ellipsoid cannot be selected if it is already defined in the Transformation or is not required if you are using a One Step or an Interpolation Transformation.

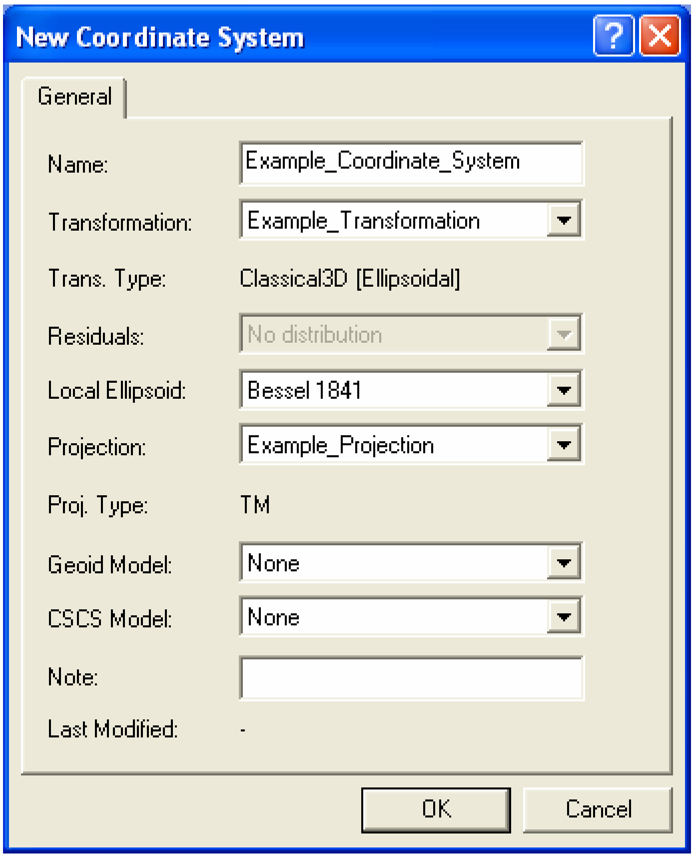
▪ Select a **Projection** from the list. Except for the Customized Projections, which are hardwired, Map Projections have to be defined before they become available in the list.

Note: A Projection is not required if you are using a One Step or an Interpolation Transformation.

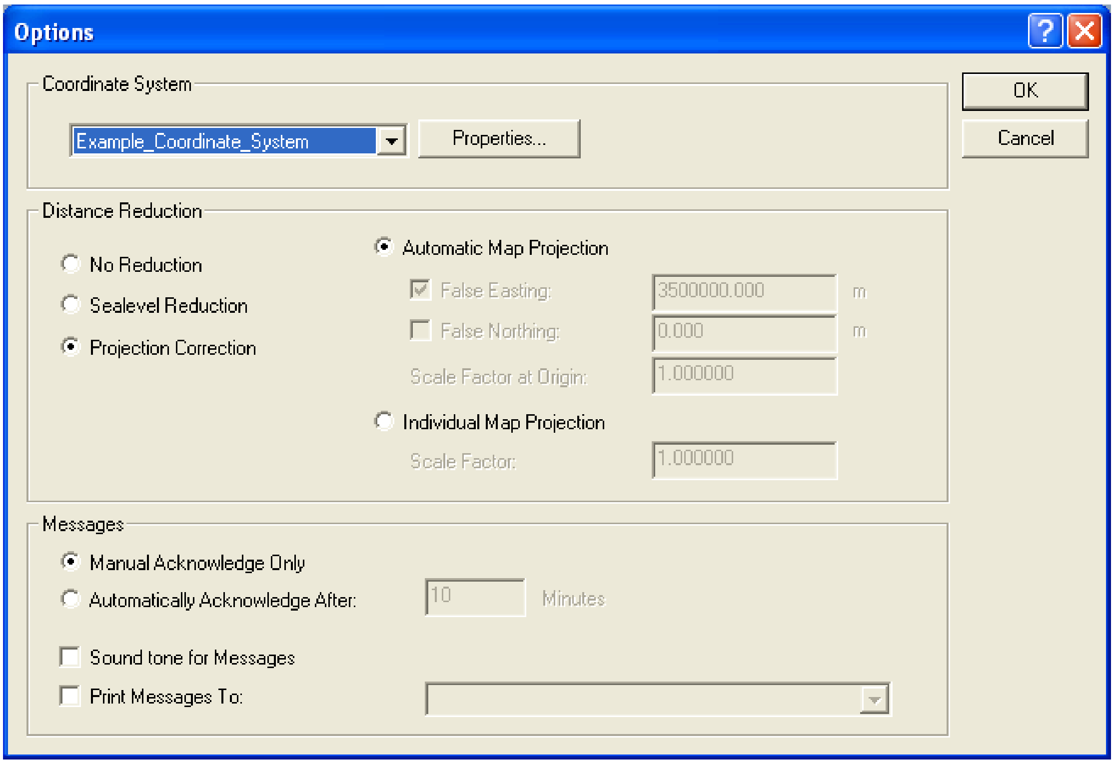
▪ If required select a **Geoid Model** from the list. Refer to Coordinate System Properties: General for the requirements to add a valid Geoid Model to the new Coordinate System.

▪ If required select a **CSCS Model** (**C**ountry **S**pecific **C**oordinate **S**ystem **M**odel) from the list. CSCS Models have to predefined before they are available in the list.

▪ Enter the optional **Note** to describe the Coordinate System.



</td></tr>
<tr><td>4</td><td>Press OK to confirm or Cancel to abort the function.</td></tr>
<tr><td>5</td><td>Close the Coordinate System Manager to return to the GeoMoS Monitor Options dialog.</td></tr>
<tr><td>6</td><td>Select your configured Coordinate System in the list box.</td></tr>
</table>

	For Distance Reduction select **Projection Correction**. If you are working with a cylindrical projection then you can choose **Automatic Map Projection** (only available for cylindrical projections), otherwise choose **Individual Map Projection**. 
7	Press **OK** to confirm or **Cancel** to abort the function.

Related topics

Options dialog

Examples of Coordinate Systems

GeoMoS Configurations

GeoMoS Monitor

The GeoMoS Monitor application is the stand alone measurement station.

The following functionality is **supported**:

- Connection to various sensors supported in Monitor (TPS, GNSS, meteorological and geotechnical sensors)
- Serial or TCP/IP connection to supported sensors
- Project management
- User levels
- Learn points
- Manual control point coordinate determination with Free Station, Intersection or GNSS update for total stations and orientation
- Automatic measurements with various options
- Blunder tolerance checks on raw data
- Information about the current system and measurement status
- Calculation of GNSS displacements
- Calculation of GNSS daily average results
- Automatic database export
- Support for the MS SQL Server 2005 Express

In the GeoMoS Monitor the following functionality is **not supported**:

- Support for the full SQL Server 2005 from Microsoft, only the SQL Server 2005 Express. The full MS SQL Server 2005 must be purchased separately.
- Automatic total station control point setup with different methods (Free Station, Distance Intersection and GNSS Update)
- Calculation of any total station results including coordinates, displacements, profiles, distance reduction (may be added using **Monitor Option 1** below)
- Calculation of total station corrections with Free Station, Distance Intersection, Orientation, PPM and Vz Correction groups (may be added using **Monitor Option 1** below)

- Calculation of daily average results of total station measurements (may be added using **Monitor Option 1** below)
- Limit check computation (may be added using **Monitor Option 2** below)
- Messaging (may be added using **Monitor Option 2** below)
- Data analysis (may be added using **GeoMoS Analyzer**)

Important:

- Each sensor requires an amount of Sensor Licenses.

GeoMoS Monitor Options

Monitor Option 1 (TPS Computation)

Upgrade to support computation of total station results.

The following functionality is **supported**:

- Automatic total station control point setup with different methods (Free Station, Distance Intersection and GNSS Update)
- Calculation of any total station results including coordinates, displacements, profiles, distance reduction
- Calculation of total station corrections with Free Station, Distance Intersection, Orientation, PPM and Vz Correction
- Calculation of daily average results of total station measurements

Monitor Option 2 (Limit Checks and Messaging)

Upgrade to support Limit Checks and Messaging.

With this option the Limit Class Editor and the Message Configurator in GeoMoS Monitor is enabled.

The following functionality is **supported**:

- Automatic computation of limit checks of measured and calculated results

- Multiple levels of limit checks (yellow, orange, red)
- Limit Level 1, Level 2 and Level 3 can be assigned independent actions
- Four different types of limit check computation (absolute, short time, long time and regression)
- Allows emails and SMS to be sent, applications to be run, the database to be queried and digital outputs to be set when defined messages are generated by the system

Monitor Option 3 (Export Service to GeoMoS Adjustment)

Upgrade to support the XML file export of monitoring data.

The following functionality is **supported**:

- Automatic and manual export of monitoring data to GeoMoS Adjustment.

GeoMoS Analyzer

GeoMoS Analyzer is an analysis tool that can be used to view data collected by any GeoMoS Monitor.

The following functionality is **supported**:

- Numerical and graphical analysis of data from the same PC as GeoMoS Monitor or the database or another PC
- More than one installation of Analyzer may access the data and do analysis simultaneously
- Site Map with images or geo-referenced maps using traffic lights symbols to display limits
- Project management
- User levels
- Outlier detection algorithm
- Set results invalid/valid
- Enter comments
- Customizable graphics
- Customizable reports with filter and search mechanism
- Manual database import and export
- Export to other systems e.g. ASCII, DXF and BMP
- Support for the MS SQL Server 2005 Express

In the GeoMoS Analyzer the following functionality is **not supported**:

- Connection of sensors
- Remote control of measurement cycles and measurements
- Editing of all settings in Monitor (may be added using **GeoMoS Monitor**)
- Re-processing of total station results (may be added using **Analyzer Option 1** below)

GeoMoS Analyzer Options

Analyzer Option 1 (TPS Post-Processing)

Support for re-processing of total station results.

The following functionality is **supported**:

- Re-processing of the coordinate system, distance reduction, meteo model and all values modified in the Data Editor.
- Data Editor to modify additive constants, reflector heights, temperature and pressure.
- Re-processing of the profile directions, instrument heights and null coordinates together with GeoMoS Monitor.

GeoMoS Adjustment

GeoMoS Adjustment is an analysis tool that can be used to simulate networks, to compute network adjustments and deformation analysis results.

The following functionality is **supported**:

- Manual import of GeoMoS XML files
- Automatic import of GeoMoS XML files
- Network adjustment computation as minimal constraint network, reference points as fixed or absolute fixed
- Deformation analysis based on the two-step method
- Numerical and graphical analysis of the network adjustment and deformation analysis data
- Network simulation capability

In the GeoMoS Adjustment the following functionality is **not supported**:

- Connection of sensors
- Remote control of measurement cycles and measurements
- Limit checks and Messaging

GeoMoS Monitor Option 3 "Export to GeoMoS Adjustment"

Support for manual and automatic export of GeoMoS XML files. The service **Export to GeoMoS Adjustment** in Leica GeoMoS Monitor is required to write GeoMoS XML files for the GeoMoS Adjustment software.

Licenses

GeoMoS is a scalable and flexible software. The new licensing concept takes the complexness of sensors in account. The customer needs only to buy the required amount of sensor licenses for the number and sensor types that are connected.

Sensor Types	Amount required per sensor
TPS Sensor ▪ TPS 1000 Series (1100/1800/2003) ▪ TPS 1100 Series ▪ TPS 1200 Series	30
GNSS Sensor ▪ GPS (NMEA)	10
Temperature Sensor (STS)	1
Pressure Sensor (STS)	1
Combined Temperature/Pressure (STS)	1
Nivel Sensor *)	3
Rain Gauge	1
Humidity (Reinhardt)	1
Combined Temp/Press/Humidity (Reinhardt)	1
Water level (Piezo DynaOpt)	1
Leica Disto	1
Spider RT Positioning Products *)	10
Spider PP Positioning Products *)	10
Each geotechnical sensors connected via the Campbell Datalogger *)	1

***) Important:**

- Nivel220 Sensor: Three sensor licenses are required for each Nivel220 sensor connected to the bus system.
- Spider RT Positioning Products: Ten sensor licenses are required for a connection to one GNSS Spider Site Server.
- Spider PP Positioning Products: Ten sensor licenses are required for a connection to one GNSS Spider Site Server.
- Campbell Datalogger: Each geotechnical sensor connected to the Campbell datalogger that is read out to GeoMoS requires one sensor license.

Customer Care Package (CCP)

Background information

With GeoMoS version 3.0 we have introduced new Customer Care Packages and integrated software maintenance and customer support.

A newer GeoMoS version can only be **installed**, if you have a valid **software maintenance key** with an **expiry date** beyond the release date of the new GeoMoS version.

GeoMoS software maintenance keys are provided through our Customer Care Program. Customer Care Packages (CCP) for GeoMoS provides you with customer support and software maintenance for your GeoMoS installation and can be ordered from Leica Geosystems. Please contact your Leica representative to learn more about our Customer Care Program.

A software maintenance key is always linked to a software protection key (software license or dongle).

A powerful and competent worldwide service and support network backs up Leica Geosystems Structural Monitoring solutions. Leica Geosystems customers benefit from our service and support that spans time zones and geography. Our Active Customer Care program provides customer packages to suit your needs, whether you use our simplest distance measuring device or the most sophisticated integrated solution. Active Customer Care is a true partnership, it's our commitment to continue to provide the level of support and collaboration you have come to expect when you put your trust in Leica Geosystems.

Getting Help

How to find a Help topic

- Click the **Contents** tab to browse through topics by category.

- or click the **Index** tab to see an alphabetically ordered list of index entries: either type the word you're looking for or scroll through the list.

- or click the **Search** tab to search for words and/or phrases that may be contained in a Help topic. Combine several phrases by logical operators for a more advanced search.

How to print Help text

You can print topics and information right from the HTML Help viewer. The available print options are determined by the version of Internet Explorer installed on your system.

To print a single topic:

1. Click **Print**.

2. Select **Print the selected topic** and click **OK**.

To print all topics in a selected book:

1. Click **Print**.

2. Select **Print the selected heading and all subtopics** and click **OK**.

Tips:

- Only from the **Contents** tab you may select to print entire books.
- If you open a topic via the **Index**, the **Search** functionality or as one of your **Favorites**, only single topics may be printed at once.

Technical Support

Technical information is available through several online services. All registered Leica Geosystems customers have access to this information. You can obtain product support in several ways:

World Wide Web

The Leica Geosystems Web Site www.leica-geosystems.com provides unlimited access to a variety of company services and product information.

Email, Fax

Contact the Leica Geosystems Dealer/Distributor in the country where you bought your product.

GeoMoS Monitor

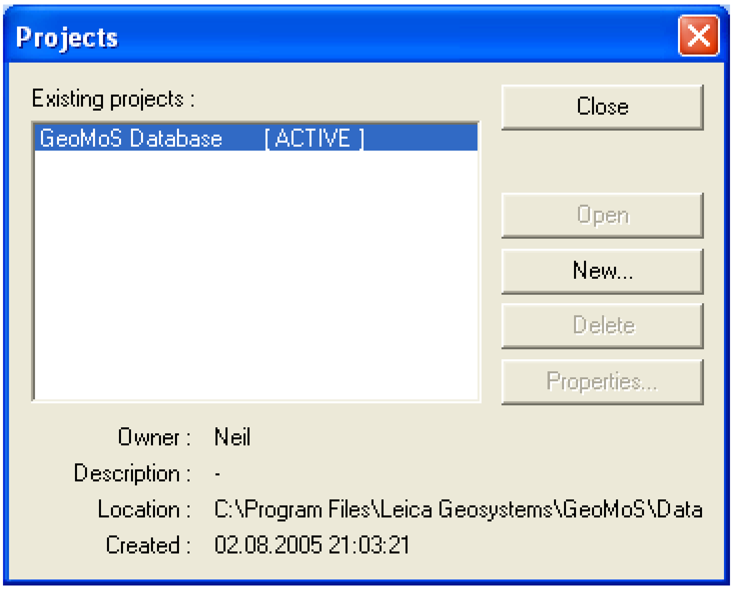
Menu

File

Projects

To open the Projects dialog

Follow these steps to open the Projects dialog.

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>Select from the menu File, Projects....</td></tr>
<tr><td>2</td><td>The Projects dialog is displayed.


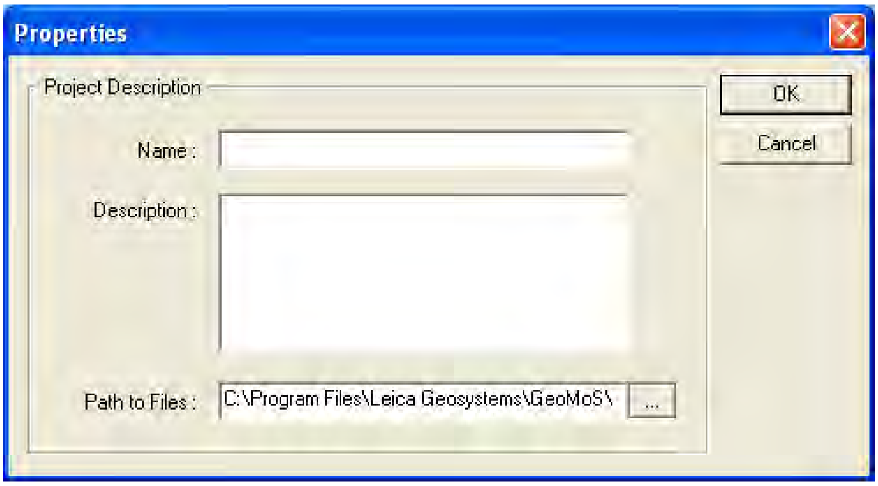
</td></tr>
</table>

Project Settings

The table below describes the fields and buttons in the Projects dialog box.

Field/Button	Description
Existing Projects	A list of the existing projects.

<table>
<tr><td>Close</td><td>Close window.</td></tr>
<tr><td>Open</td><td>Opens the selected project.

Note: A different project may be open in both Monitor and Analyzer.</td></tr>
<tr><td>New...</td><td>

<table>
<tr><td>**Name**</td><td>Enter the name of the new project. This name will also be used as the name of the database.</td></tr>
<tr><td>**Description**</td><td>Enter a description of the monitoring project.</td></tr>
<tr><td>**Path to Files**</td><td>Select the path for the database files.

Important: Only local hard drives are permitted to store the GeoMoS Monitor database file.</td></tr>
</table></td></tr>
<tr><td>Delete</td><td>Delete the database. All data will be lost. It is not possible to delete the active project.</td></tr>
<tr><td>Properties...</td><td>Use this option to edit the name, description and the path of an existing project.</td></tr>
</table>

Analyzer

To open Analyzer

- Select from the menu **File**, **Analyzer**.

The GeoMoS Analyzer application is started parallel to GeoMoS Monitor. In GeoMoS Analyzer the displacement, velocity and vector information can be displayed either graphically or numerically. The data can also be edited and post-processed.

User Level

Background information

There are three user levels which determine the functionality allowed by the operator in the system:

- Viewer
- Us er
- Adminis trator

The Administrator has full access to all functionality, while the User and Viewer have restricted access to the system, as shown in the table below. A password is required to change to a higher level of user access. No password is required to change to a lower user level. When the password is active, the application starts in the lowest user level status of Viewer. The password protection can be configured.

User Level	Rights
Viewer	▪ Re stricted. ▪ Can view overview, last actions, messages and observations. ▪ Cannot make any changes to operation, configuration or close program.
User	▪ Re stricted. ▪ Can start and stop measuring, edit points, point groups, profiles and measurement cycles. ▪ Cannot change critical settings such as limit classes, event messages, point coordinates, delete database records or close program.
Administrator	▪ Full.

Note: The User Level is configured independently for Monitor and Analyzer.

To open User Level:

Follow these steps to open the user level.

Step	Action
1	Select from the menu **File**, **User Level...** or click on the toolbar **User Level button** .
2	The **User Level** dialog is displayed.
3	Select the desired user level.
4	If the new user level is lower than the existing user level, then no further entry is necessary and the dialog can be closed by pressing the OK button. If the new user level is higher than the existing user level a **Password** dialog will be displayed automatically.
5	Enter the Password for the new user level and press the OK button. The password is case sensitive. The **User Level** dialog will be automatically closed if the password is correct.

The available functionality and access rights for the selected user level will be activated. The functionality that is not accessible for a particular user level will be grayed out. The current user level is displayed in the Status Bar.

Set Password

Passwords can be defined to protect the access to the various user levels. When Administrator is selected as the user level in the **User Level** dialog, the **Settings** button is active. The password for the User and the Administrator can be set in the **Set Password** dialog.

Follow these steps to set a Password.

Step	Action
1	Change to the user level to ’Administrator’.
2	Select the menu **File**, **User Level...**.

3	Click the **Set Password** button.
4	The **Settings** dialog is displayed.
5	Edit the passwords for User and Administrator.
6	Click the **OK** button.
7	The **Settings** dialog will be displayed again.
8	Repeat the entry for the passwords and confirm with the OK button.
9	The **Settings** dialog will be closed and the passwords will be saved.

After the second confirmation the passwords will be saved and activated. A password dialog will appear when changing to a higher user level. It is only possible to change the user level when the correct password for the respective user level is entered. When the password fields for the User and Administrator are empty, it is not necessary to enter a password to change between user levels. If only one password is entered the **Settings** dialog cannot be confirmed with the **OK** button.

Page Setup

To open Page Setup

Follow these steps to open Page Setup.

1	Select the menu **File**, **Page Setup....**
2	The **Page Setup** dialog is displayed.
3	Select the preferred printer and change the print properties as required.
4	Confirm the selected printer and properties by pressing the **OK** button. The **Page Setup** dialog will be closed and the Page Setup settings will be saved.

Print Preview

To open Print Preview

Follow these steps to open the Print Preview.

Step	Action
1	Select from the menu **File**, **Print Preview**.
2	The **GeoMoS Monitor** print preview will be displayed. The window shows the active view with the defined page setup.

The buttons have the following functionality

Button	Description
Print...	Prints the current print preview.
Next	Shows the print preview of the next page.
Previous	Shows the preview of the previous page.
Two Pages / One Page	Shows one or two pages at a time.
Zoom Out	Zooms out.
Zoom In	Zooms in.
Close	Closes the print preview window and returns to the application.

Print

To open the Print dialog:

Follow these steps to open the Print dialog.

Step	Action
1	Select Menu **File**, **Print...**.
2	The **Print** dialog appears.
3	Change the printer settings as required.
4	Press the **OK** button or press the **Print button** or press the keys **Ctrl+P**.

The graph or the report of the active pane will be printed with the selected printer settings.

Exit

To Exit:

- Select from the menu **File**, **Exit**.

Ends the GeoMoS Monitor application. **All measurement cycles and data transfer is stopped!** If the measurement cycle is active when the program is close, the measurement cycle will be activated and continue to measure when the GeoMoS Monitor is started again.

View

Configuration Toolbar

- Select from the menu **View**, **Configuration Toolbar**.

  Shows or hides the Configuration Toolbar. A check mark is shown next to the menu item when the toolbar is visible.

Configuration Toolbar

Point Group Toolbar

- Select from the menu **View**, **Point Group Toolbar**.

  Shows or hides the Point Group Toolbar. A check mark is shown next to the menu item when the toolbar is visible.

Remark:

When the automatic measurement cycle is not running, the selected **Point Group** can be manually measured from the toolbar with the menu item Measurement, Start/Stop Point Group. When the Measurement Cycle is started, the point group field is deactivated, and the current point group that is being measured is displayed.

Point Group Toolbar

Measurement Toolbar

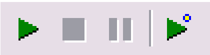
- Select from the menu **View**, **Measurement Toolbar**.

Shows or hides the Measurement Toolbar. A check mark is shown next to the menu item when the toolbar is visible.

Remarks:

The buttons **Start**, **Stop** and **Pause** are associated with the automatic measurement cycle and the **Measure Point Group button** is associated with manual measurements.

Measurement Toolbar



Status Bar

- Select from the menu **View**, **Status Bar**.

  Shows or hides the Status Bar. A check mark is shown next to the menu item when the Status Bar is visible.

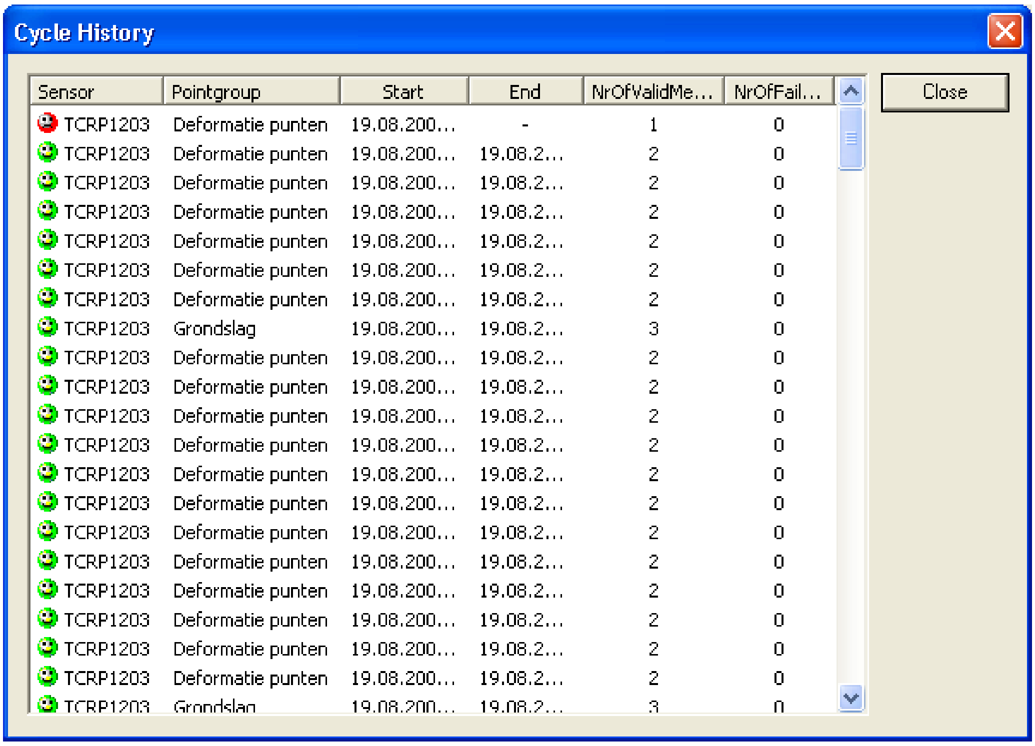
Status Bar

Cycle History

To open Cycle History:

1. Select from the menu **View**, **Cycle History...**.
2. The **Cycle History** is displayed.

The Cycle History shows a list of all total stations measurement cycles, including the name of the sensor, the point group measured, the start and end time of measurement, the number of valid measurements and the number of failed measurements



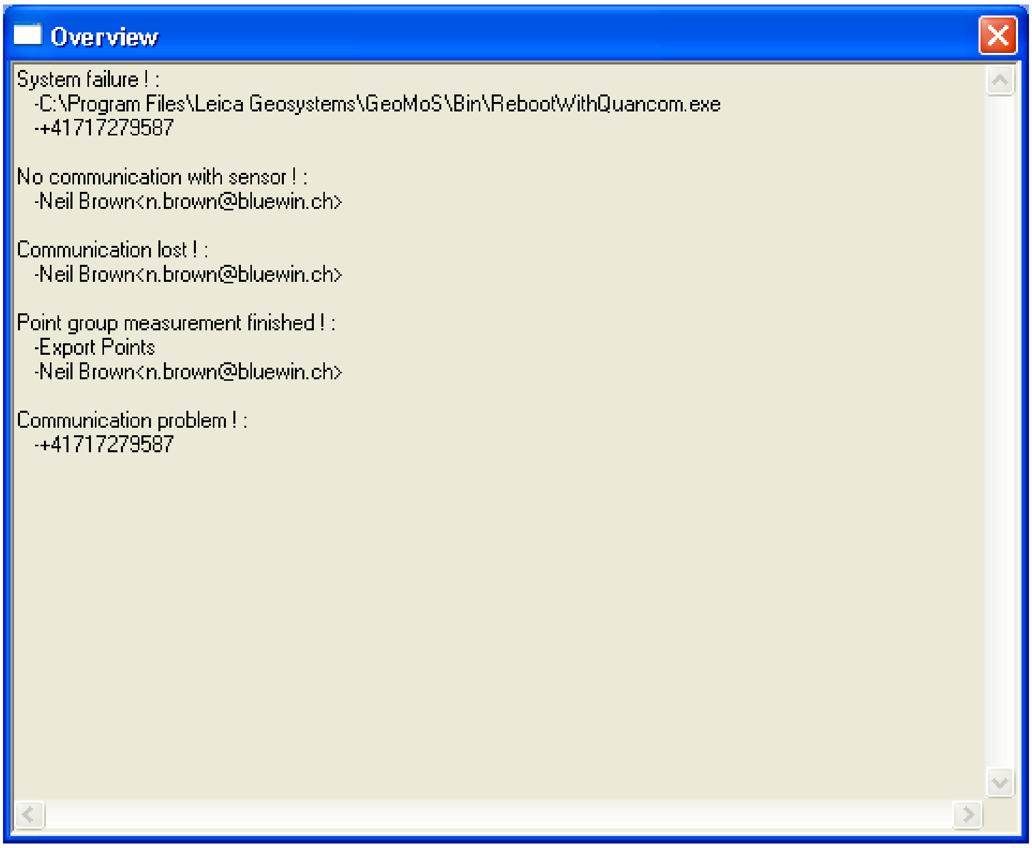
Sensor	Pointgroup	Start	End	NrOfValidMe...	NrOfFail...
TCRP1203	Deformatie punten	19.08.200...	-	1	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Grondslag	19.08.200...	19.08.2...	3	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Deformatie punten	19.08.200...	19.08.2...	2	0
TCRP1203	Grondslag	19.08.200...	19.08.2...	3	0

Action Overview

To open Action Overview:

1. Select from the menu **View**, **Action Overview...**.
2. The **Action Overview** is displayed.

The Action Overview shows all the definitions you made between messages and actions.

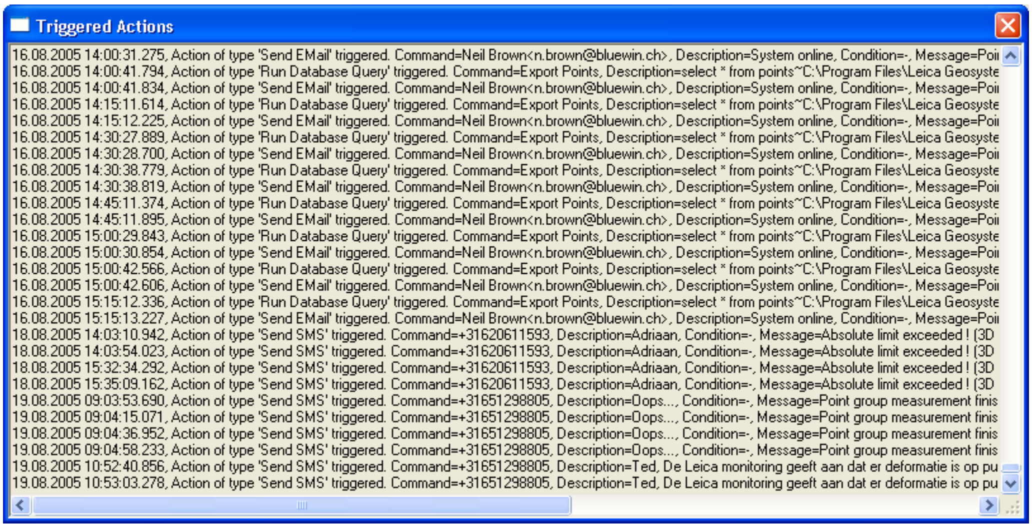


Action History

To open ActionHistory:

1. Select from the menu **View**, **Action History...**.
2. The **Action History** is displayed.

The Action History shows a list of all actions which have been executed. The list includes the time of the action, the type of the action and the configuration details of the action. Refer to the Message Configurator for more information on Actions.



Free Station Log File

To open the Free Station Log File

- Select from the menu **View**, **Free Station Log File...**.

For each free station computation the Free Station Logfile is updated. All values are given in [m] for distances and [gon] for angles in this Free Station Logfile. The units cannot be changed in the Free Station Log File.

The free station kernel uses a robust computation method. For the weighting a modified form of the general principle of least-squares adjustment is applied &endash; in simplest terms, the least-squares technique is adopted with ”robust weighting”. Weights are calculated depending on the fit between the observed and the computed value for an observation. Therefore, observations which are in good agreement with the computed values are awarded higher weights relative to those which have large differences between observed and computed values. The advantage of the robust weighting is that it enables good results to be obtained even if errors are within the data. Bad data is effectively ”de-weighted” and therefore has little or no influence upon the results.

Note: If all measurements are of high quality the results for the robust method will be consistent with the results of the least squares method.

Read below to learn about all Free Station Log File properties in detail

Example	
1.	14.09.2006 11:00:43.730 ### 14.09.2006 11:00:43.730 Processing pointgroup 'TPS1_FreeStation'...
2.	14.09.2006 11:00:43.730 Station point: 'TPS1-Station' 14.09.2006 11:00:43.762 Station coords: 999.519,999.536,1000.003
3.	14.09.2006 11:00:43.777 Reference coordinates of 'TPS1-1009': E=907.9719,N=1350.6892,H=1037.6995

4.	14.09.2006 11:00:43.777 Calculated polar reference of 'TPS1-1009': 138.4527,93.4131,364.9005
5.	14.09.2006 11:00:43.793 Measurement of 'TPS1-1009' at 14.09.2006 11:00:16: Hz=138.4538, V=93.4126, Slope=364.8916, Temperature=28.2, Pressure=961.4, AtmosPPM=29.7, SlopeAtmosPPMCorrected=364.902, NullDist=364.900, SlopeDistDiff=0.002, RefPPM=24.287, VzCorr=399.9995, Azimuth=383.7645, Orientation=245.3106
6.	14.09.2006 11:00:43.808 Reference coordinates of 'TPS1-1010': E=937.2932,N=877.3344,H=996.2526 14.09.2006 11:00:43.808 Calculated polar reference of 'TPS1-1010': 384.6719,101.7410,137.2053 14.09.2006 11:00:43.808 Measurement of 'TPS1-1010' at 14.09.2006 11:00:30: Hz=384.6712, V=101.7403, Slope=137.2005, Temperature=28.2, Pressure=961.4, AtmosPPM=29.7, SlopeAtmosPPMCorrected=137.205, NullDist=137.205, SlopeDistDiff=-0.001, RefPPM=34.722, VzCorr=399.9993, Azimuth=229.9837, Orientation=245.3125
7.	14.09.2006 11:00:43.840 Reference coordinates of 'TPS1-1016': E=1214.1226,N=1036.8612,H=1012.6138 14.09.2006 11:00:43.840 Calculated polar reference of 'TPS1-1016': 243.7255,96.3200,218.2246 14.09.2006 11:00:43.840 Measurement of 'TPS1-1016' at 14.09.2006 11:00:44: Hz=243.7252, V=96.3204, Slope=218.2197, Temperature=28.2, Pressure=961.4, AtmosPPM=29.7, SlopeAtmosPPMCorrected=218.226, NullDist=218.225, SlopeDistDiff=0.002, RefPPM=22.349, VzCorr=0.0004, Azimuth=89.0373, Orientation=245.3121
8.	14.09.2006 11:00:43.840 Number of measured reference points: 3
9.	14.09.2006 11:00:43.855 Orientation: 245.3117, 0.0010 14.09.2006 11:00:43.855 VzCorrection: 399.9997, 0.0006 14.09.2006 11:00:43.855 PPM: 27.1194, 6.6551
10.	14.09.2006 11:00:43.855 -- 14.09.2006 11:00:43.855 Results of free station calculation (Reduced). Solution:ROBUST [GON/M]
11.	14.09.2006 11:00:43.871 Station Coordinates: 999.5176, 999.5356, 1000.0019 14.09.2006 11:00:43.871 Standard Deviations: 0.0006, 0.0006, 0.0013
12.	14.09.2006 11:00:43.871 Orientation: 245.31165, 0.000395" 14.09.2006 11:00:43.871 Scale: 1.00000312, 0.00000181
13.	14.09.2006 11:00:43.871 Hz, HzResid, HDist, ResidHDist, HeightDiff, ResidHDiff, E, N, H 14.09.2006 11:00:43.871 138.45382, 0.000770, 362.8917, 0.0001, 37.6996, 0.0021, 907.9719, 1350.6892, 1037.6995 14.09.2006 11:00:43.871 384.67121, -0.000515, 137.1319, 0.0001, -3.7489, 0.0004, 937.2932, 877.3344, 996.2526 14.09.2006 11:00:43.887 243.72521, -0.000260, 217.8272, -0.0003, 12.6093, -0.0025, 1214.1226, 1036.8612, 1012.6138

	Description	Additional technical details
1.	Start of the control point group type Free Station.	Last TPSSetup is used to determine the free station.
2.	Point ID of the used control point and the coordinates.	The coordinate type 'current' is used.
3.	Point ID of the first measured reference point in the Free Station point group with the used coordinates of type 'reference'.	The coordinate type 'reference' is used.
4.	Calculated polar values from the control point to the measured reference point.	For the reference point the coordinate type 'reference' is used.

5.	▪ Raw measurement of the values: Hz, V, Slope Distance ▪ Used atmospheric conditions: Temperature, Pressure ▪ Computed results out of the raw measurements: AtmosPPM, PPM corrected slope distance, NullDist, SlopeDistDiff, RefPPM, Vz Correction, Azimuth, Orientation	NullDist = Calculated polar slope distance. SlopeDistDiff = Difference between NullDist and measured Slope Distance
6.	Step 3 to 5 for the second reference point.	
7.	Step 3 to 5 for the third reference point.	
8.	Number of measured reference points.	The message 'Point not found' or 'Out of tolerance' decreases the number of measured reference points. If the minimum number of reference points is not reached the control point coordinate is not updated with new coordinates.
9.	Computed orientation, Vz Correction and PPM with the standard deviations.	The computed orientation, Vz correction and PPM value as average of the measurements to the reference points. Note: ▪ These values are only used for the point groups OrientationOnly, Vz Correction and PPM. ▪ OrientationOnly point groups: If a single reference point is measured in the OrientationOnly point group this values is used.
10	Start of the computation (robust	

	method).	
11.	Computed new control point coordinates (easting, northing, height) with the standard deviations.	The new determined control point inserts a new TPSSetup entry.
12.	Computed orientation and scale	The computed orientation and scale factor from the robust computation method. The orientation is only used if the in the Free Station Group Properties the checkbox Orientation is selected. The scale is never used. Note: ▪ OrientationOnly point groups: If more than one reference point is measured in the OrientationOnly point group this value is used.
13.	Input of the measured reference points and residuals of the computation.	Input values: Hz angle, horizontal distance, height difference, easting, northing and height (coordinates type 'reference'). The horizontal distances and height differences are computed with the corrections and reductions as configured in the Options dialog. Output values: Hz residuals, Horizontal Distance residuals and Height Difference residuals.

Signal Scan

To open Signal Scan

- Select from the menu **View**, **Signal Scan...**.

Refer to the Signal Scan Measurement Mode technical description for a description of the signal scan and an explanation of the view.

Note: The Signal Scan view will not be displayed correctly if more than one total station are measuring using signal scan at the same time. The view is intended only for single total stations.

Related Topics

Measurement Modes

Signal Scan Measurement Mode

Configuration

ComBox Manager

ComBox Manager - Overview

Background Information

The **ComBox Manager** helps you to configure each connected **Leica ComBox** and to manage the connected ComBoxes within GeoMoS.

The ComBoxes can be configured:

- **with the Leica ComBox Manager on the Leica M-Com ComBox CD-ROM**
- **with the Leica ComBox Manager in the Leica GeoMoS Monitor Software**

Note: The difference between these two options is that in the first option you just configure the ComBox. With the second option you configure and insert the ComBox settings into the database of GeoMoS, which are required if you use a ComBox in a GeoMoS project.

There are two different communication boxes available:

- **Leica ComBox10**
- **Leica ComBox20**

The Leica ComBoxes are part of the **Leica M-Com series**. The communication boxes provides the communication from the sensors in the field to the Internet via a mobile communication provider.

- The ComBox10 can connect up to two sensors to the Internet.
- The ComBox20 can connect up to four sensors to the Internet.
  Additionally the box contains one meteo sensor and three Power over Ethernet (PoE) access points, for example to connect a PoE webcam.
- Both ComBoxes are also available together with a MonBox30, which can be mounted on a frame in the boxes.

Requirements

To use a ComBox the following items are essential and must be organised locally prior to installation:

- **From your Mobile Provider:**
  - A ***SIM card*** for the wireless router, that supports the connection from the Internet to the wireless router via a public IP address.
  - A ***GPRS / UMTS breakout number*** or a standard telephone number.
  - If essential, an ***user name and a password***.
  - The knowledge about the ***Access Point Name***.
  - The knowledge about the ***Authentication method***: Challenge Handshake Authentication Protocol (CHAP) or Password Authentication Protocol (PAP).
  - The knowledge about the ***PPP (Point-to-Point Protocol) DNS query***: Specification whether a DNS request to the provider is made or not.
- **From Dynamic Network Services Inc. a DynDNS Account with following details:**
  - an ***user name and a password***.
  - a ***host name***, for example myComBox.dyndns.org.
  - a ***server address***, normally ”members.dyndns.org” is used.
  - a ***server port***, normally 80 or 8245.

Refer to the chapter How to configure a DynDNS account for ComBoxes

Open the ComBox Manager from the supplied M-Com ComBox CD-ROM

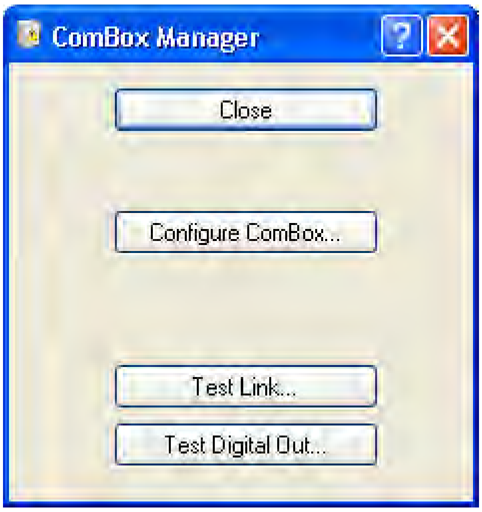
Follow these steps to open the ComBox Manager from the supplied M-Com ComBox CD-ROM:

Step	Action
1	The ComBox is physically connected either via LAN or Internet to the computer where the ComBox Manager will be started. Refer to the ComBox User Manual, Chapter "3 Operation", for more details about the preparation of the ComBox.
2	Insert the **Leica M-Com ComBox CD-ROM** in your CD/DVD drive of your notebook or desktop PC and start the CD.
3	Select **Software**, **Leica ComBox Manager.**
4	The **ComBox Manager** dialog with the control buttons will be shown.
5	Use the **Configure ComBox...** button to configure a connected ComBox.

6	Use the **Test Link...** button to test the connection to the selected ComBox and all its included modules.
7	Use the Test **Digital Out...** button to display and change the state of the Digital I/O outputs of the connected ComBox.
8	Click the **Close** button. The **ComBox Manager** dialog will be closed.

Note: The above description guided you through the creation process by describing the minimum settings only.

Read below or click on the ComBox Manager image to learn about all properties in detail



The table below describes the fields and buttons in the ComBox Manager dialog box.

Field/Button	**Description**
	Press the **Close** button to close the ComBox Manager dialog.
	Use the **Configure ComBox...** button to configure ComBox. 1. The **ComBox - Connect** dialog will be shown. Firstly you have to choose the appropriate connection type how your

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ComBox is connected to ComBox Manager:

▪ Connect via LAN (the ComBox is connected via an Ethernet cable to the computer where ComBox Manager is running)
▪ Connect via Internet (a host name (DynDNS name) of the ComBox and the port number of the wireless router are required)

Note: When you configure your ComBox the first time, you have to select "Initial Startup" and a LAN connection is required.

You find more details about ComBox connections under following link: ComBox - Connect

2. After the connection type is selected a connection to the ComBox will be established and all settings will be read.
3. If the connection establishment was successfully the Setup ComBox wizard will be shown.
4. Now follow the wizard step by step and insert all settings in each register. At the end of the wizard press the button Apply. All settings will be written to the ComBox.

You find more details about the settings under following link: ComBox - Configuration

5. After the configuration the ComBox will reboot.
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<td>
Use the Test Link... button to test the connection to the selected ComBox and all its included modules.

1. The ComBox - Connect dialog will be shown. Firstly you have to choose the appropriate connection type how your ComBox is connected to ComBox Manager:

▪ Connect via LAN (the ComBox is connected via an Ethernet cable to the computer where ComBox Manager is running)
▪ Connect via Internet (a host name (DynDNS name) of
</td>
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</table>

	the ComBox and the port number of the wireless router are required) You find more details about ComBox connections under following link: **ComBox - Connect** 2. After the connection type is selected a connection to the ComBox will be established. 3. If the connection establishment was successfully the **Test Link - Progress** dialog will be shown. This dialog will show the test status of all modules which are included in a ComBox. You find more details about this test under following link: **ComBox - Test Link** 4. After the test you can close the dialog.
	Use the **Test Digital Out...** button to display and change the state of the Digital I/O outputs of the selected ComBox. 1. The **ComBox - Connect** dialog will be shown. Firstly you have to choose the appropriate connection type how your ComBox is connected to ComBox Manager: ▪ Connect via LAN (the ComBox is connected via an Ethernet cable to the computer where ComBox Manager is running) ▪ Connect via Internet (a host name (DynDNS name) of the ComBox and the port number of the wireless router are required) You find more details about ComBox connections under following link: **ComBox - Connect** 2. After the connection type is selected a connection to the ComBox will be established. 3. If the connection establishment was successfully the **ComBox - Test Digital Out** dialog will be shown. This dialog will show the state of the Digital I/O outputs and gives the opportunity to recycle the power of the

	appropriate ports. You find more details about this test under following link: **ComBox - Test Digital Out** 4. After the test you can close the dialog.

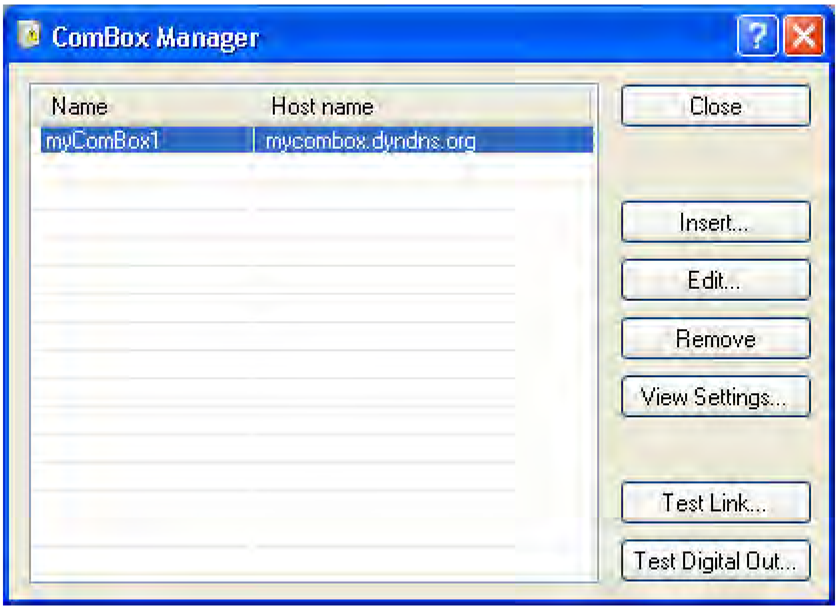
Open the ComBox Manager in GeoMoS Monitor

Follow these steps to open the ComBox Manager in GeoMoS Monitor:

Step	Action
1	The ComBox is physically connected either via LAN or Internet to the computer where GeoMoS Monitor is running. Refer to the ComBox User Manual, Chapter "3 Operation", for more details about the preparation of the ComBox.
2	Select in GeoMoS Monitor the menu **Configuration**, **ComBox Manager...**
3	The **ComBox Manager** dialog will be shown. In the list on the left-hand side of the dialog all configured ComBoxes are listed which are inserted into GeoMoS. The list is devided into two sections: The name and the host name of each ComBox is displayed. On the right-hand side you see all control buttons.
4	Use the **Insert...** button to configure and insert a ComBox into GeoMoS.
5	If you wish to edit a ComBox, please select the appropriate ComBox in the list and using the **Edit...** button.
6	Press the **Remove** button to delete a selected ComBox.
7	Use the **View Settings...** button to get an quick overview of all settings which are assigned to the selected ComBox.
8	Use the **Test Link...** button to test the connection to the selected ComBox and all its included modules.
9	Use the Test **Digital Out...** button to display and change the state of the Digital I/O outputs of the selected ComBox.
10	Click the **Close** button. The **ComBox Manager** dialog will be closed.

Note: The above description guided you through the creation process by describing the minimum settings only.

Read below or click on the ComBox Manager image to learn about all properties in detail



The table below describes the fields and buttons in the ComBox Manager dialog box.

Field/Button	**Description**
Name	The name of the ComBox. Each ComBox must have an unique name.
Host name	The host name of the ComBox. Each ComBox has an own host name. It is the TCP/IP address of the ComBox and corresponds to the created **DynDNS name** in your DynDNS account which you must create when you would like to use ComBoxes. With this address you can localize your ComBox and communicate with it.
	Press the **Close** button to close the ComBox Manager dialog.

<table>
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<td>Insert...</td>
<td>
Use the Insert... button to configure and insert a ComBox into GeoMoS.

The ComBox - Connect dialog will be shown. Firstly you have to choose the appropriate connection type how your ComBox is connected to GeoMoS:

Connect via LAN (the ComBox is connected via an Ethernet cable to the computer where GeoMoS is running)
Connect via Internet (a host name (DynDNS name) of the ComBox and the port number of the wireless router are required)

Note: When you configure your ComBox the first time, you have to select "Initial Startup" and a LAN connection is required.

You find more details about ComBox connections under following link: ComBox - Connect

After the connection type is selected a connection to the ComBox will be established and all settings will be read.
If the connection establishment was successfully the Setup ComBox wizard will be shown.
Now follow the wizard step by step and insert all settings in each register. At the end of the wizard press the button Apply. All settings will be written to the ComBox and into GeoMoS.

You find more details about the settings under following link:
ComBox - Configuration

After the configuration the ComBox will reboot.

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<tr>
<td>Edit...</td>
<td>
Use the Edit... button to edit a selected ComBox.

The ComBox - Connect dialog will be shown. Firstly you have to choose the appropriate connection type how your ComBox is connected to GeoMoS:

Connect via LAN (the ComBox is connected via an Ethernet cable to the computer where GeoMoS is running)
Connect via Internet (a host name (DynDNS name) of the

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<tr><td></td><td>ComBox and the port number of the wireless router are required)

You find more details about ComBox connections under following link: ComBox - Connect

Note: If you would like to edit your ComBox over a LAN connection, make sure that the selected ComBox in the ComBox Manager dialog corresponds to the ComBox which is physically connected to the LAN.

2. After the connection type is selected a connection to the ComBox will be established and all settings will be read.
3. If the connection establishment was successfully the Setup ComBox wizard will be shown.
4. Now you can edit your appropriate settings in the registers. At the end of the editing press the button Apply. All settings will be written to the ComBox and into GeoMoS.

You find more details about the settings under following link: ComBox - Configuration

5. After the configuration the ComBox will reboot.</td></tr>
<tr><td></td><td>Press the Remove button to delete a selected ComBox in GeoMoS.

Note: It will just delete the ComBox settings in the GeoMoS database. The correspondent settings on the appropriate ComBox are still stored.</td></tr>
<tr><td></td><td>Use the View Settings... button to get an quick overview of all settings which are assigned to the selected ComBox.

Note: There is no connection to the appropriate ComBox required. The View settings dialog will just display the stored settings in GeoMoS.</td></tr>
<tr><td></td><td>Use the Test Link... button to test the connection to the selected ComBox and all its included modules.

1. The ComBox - Connect dialog will be shown. Firstly you have to choose the appropriate connection type how your ComBox is connected to GeoMoS:

▪ Connect via LAN (the ComBox is connected via an Ethernet</td></tr>
</table>

<table>
<tr>
<td></td>
<td>
cable to the computer where GeoMoS is running)
▪ Connect via Internet (a host name (DynDNS name) of the ComBox and the port number of the wireless router are required)

You find more details about ComBox connections under following link: ComBox - Connect

2. After the connection type is selected a connection to the ComBox will be established.
3. If the connection establishment was successfully the Test Link - Progress dialog will be shown. This dialog will show the test status of all modules which are included in a ComBox.

You find more details about this test under following link: ComBox - Test Link

4. After the test you can close the dialog.
</td>
</tr>
<tr>
<td>


</td>
<td>
Use the Test Digital Out... button to display and change the state of the Digital I/O outputs of the selected ComBox.

1. The ComBox - Connect dialog will be shown. Firstly you have to choose the appropriate connection type how your ComBox is connected to GeoMoS:

▪ Connect via LAN (the ComBox is connected via an Ethernet cable to the computer where GeoMoS is running)
▪ Connect via Internet (a host name (DynDNS name) of the ComBox and the port number of the wireless router are required)

You find more details about ComBox connections under following link: ComBox - Connect

2. After the connection type is selected a connection to the ComBox will be established.
3. If the connection establishment was successfully the ComBox - Test Digital Out dialog will be shown. This dialog will show the state of the Digital I/O outputs and gives the opportunity to recycle the power of the appropriate ports.
</td>
</tr>
</table>

	You find more details about this test under following link: **ComBox - Test Digital Out** 4. After the test you can close the dialog.

ComBox - Connect

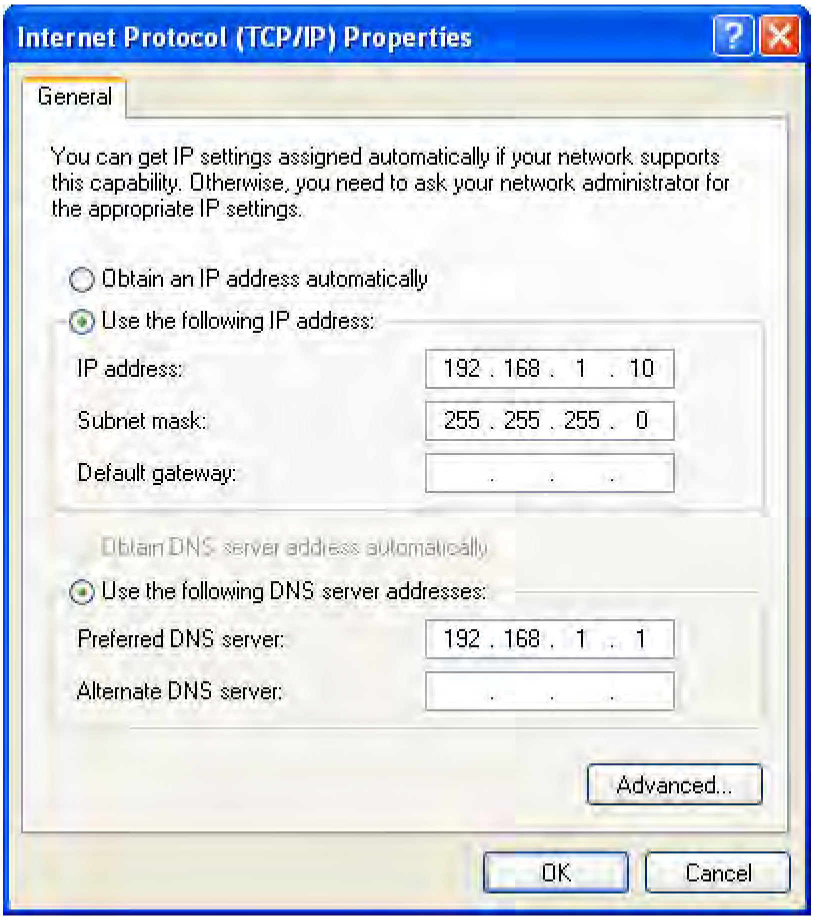
Background information

The **ComBox - Connect** dialog will be shown whenever you would like to create a connection to a ComBox. This happens when you press in the ComBox Manager dialog the button:

- Insert...
- Edit...
- Test Link...
- Test Digital Out...

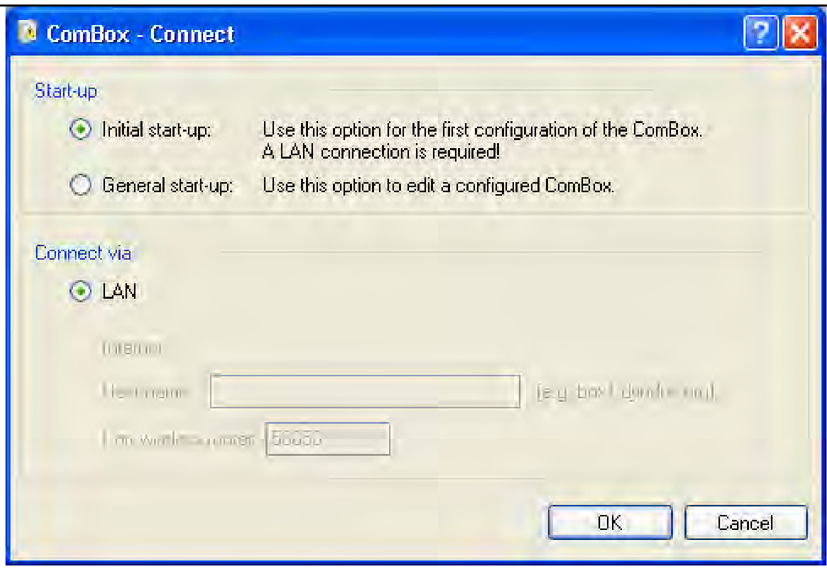
You always have to choose the appropriate connection type how your ComBox is connected to the ComBox Manager:

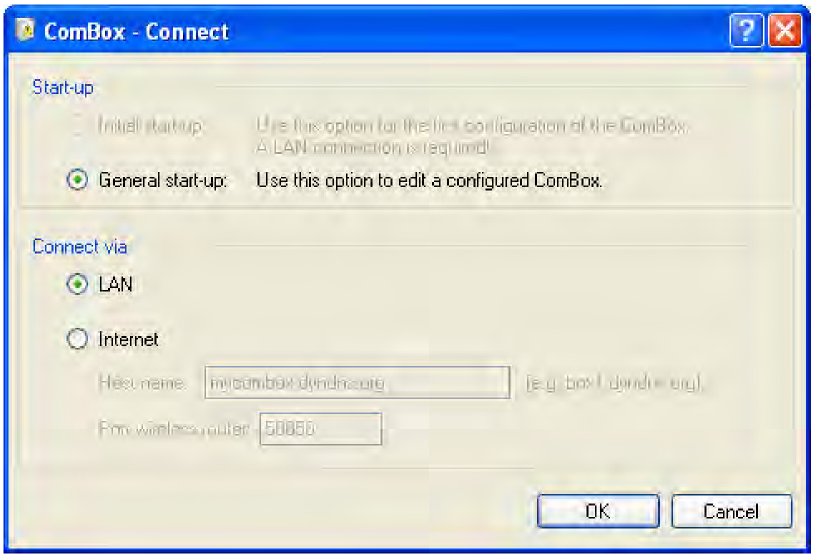
- C onnect via **LAN** (the ComBox is physically connected via an Ethernet cable to the computer where the ComBox Manager is running. Do not forget to change the IP address of the notebook or desktop PC in order that the computer works in the same network as the ComBox. Please use for your computer following **IP address: 192.168.1.10**. Refer to the ComBox Manual, Chapter "3.3 Configuration", for more information.)



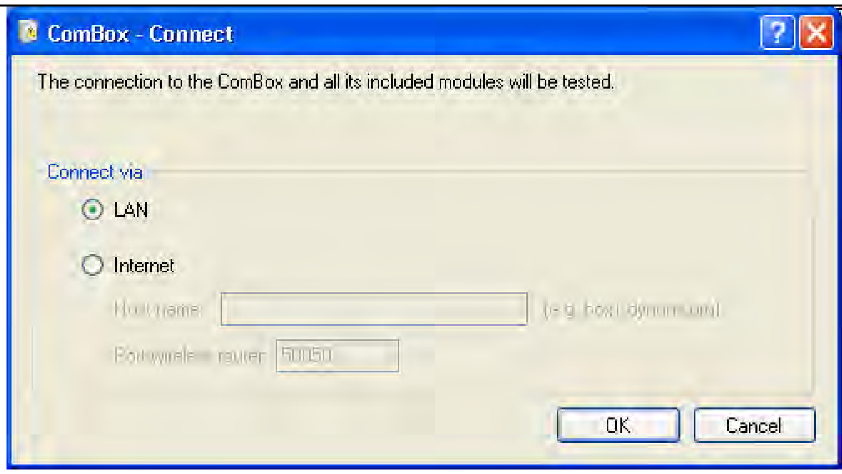
- Connect via **Internet** (the host name (DynDNS name) of the ComBox and the port number of the wireless router are required)

Use Cases

Use Case	Description
	 ▪ **Initial start-up:** When you configure your ComBox the first time, you have to select "**Initial Startup**" and the connection type "**LAN**". The ComBox must be physically connected with a Ethernet cable to the computer where GeoMoS is running (Local Area Network, LAN). Please refer to the ComBox User Manual, Chapter "3.1 Preparation", how to connect the ComBox to the computer. ▪ **General start-up:** If your ComBox is already configured (all settings are already stored on the ComBox) and you just would like to insert the ComBox into GeoMoS, then you can select "**General start-up**" and choose between a "**LAN**" or "**Internet**" connection. To use the Internet connection the host name (DynDNS name) of the ComBox and the port number of the wireless router are required.

<table>
<tr>
<td>
</td>
<td>

Initial start-up:
This option cannot be chosen due the ComBox is already configured and inserted in GeoMoS.
General start-up:
Use this option to edit a configured ComBox. You can choose between a "LAN" or "Internet" connection. For the option "Internet" the host name (DynDNS name) and the port number of the wireless router will be automatically set in the text field. They cannot be changed.

Note: If you would like to edit your ComBox over a LAN connection (the ComBox is connected via an Ethernet cable to the computer where GeoMoS is running), make sure that the selected ComBox in the ComBox Manager dialog corresponds to the ComBox which is physically connected to the LAN.</td>
</tr>
<tr>
<td>
</td>
<td>

You can test the connection to the ComBox and all its included modules</td>
</tr>
</table>

<table>
<tr>
<td></td>
<td>over two possibilities:

▪ LAN (the ComBox must be physically connected with a Ethernet cable to the computer where the ComBox Manager is running (Local Area Network, LAN). Please refer to the ComBox User Manual, Chapter "3.1 Preparation", how to connect the ComBox to the computer.)
▪ Internet
To use the Internet connection the host name (DynDNS name) of the ComBox and the port number of the wireless router are required.</td>
</tr>
<tr>
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<td>

You can test the state of the Digital I/O outputs of the ComBox over two possibilities:

▪ LAN (the ComBox is connected via an Ethernet cable to the computer where the ComBox Manager is running)
▪ Internet
To use the Internet connection the host name (DynDNS name) of the ComBox and the port number of the wireless router are required.</td>
</tr>
</table>

ComBox - Configuration

Background information

The **Setup ComBox** wizard will guide you through the configuration procedure of a ComBox.

The configuration procedure is divided in four parts:

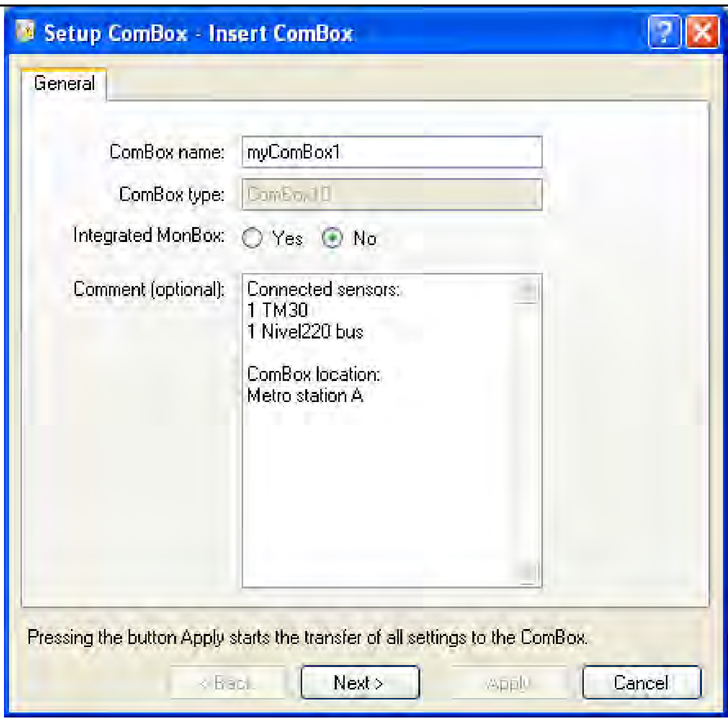
- **General**: General settings (e.g. ComBox name, type, etc.)
- **Mobile Provider**: Settings from the mobile provider (e.g. phone number, login data, access point name, etc.)
- **DynDNS**: Settings from the DynDNS account (host name, server address, login data, etc.)
- **Advanced**: Port settings (port numbers, baud rates of the ports, etc.)

Note: To open the Setup ComBox wizard, please follow the instructions on the page **ComBox Manager - Overview**.

Procedure

Follow these steps to configure a ComBox.

<table>
<tr><th>Step/Register</th><th>Action</th></tr>
<tr><td>General</td><td>



<table>
<tr><th>Field/Button</th><th>Description</th></tr>
<tr><td>ComBox name</td><td>Define a Name for the ComBox.

Note: Each ComBox needs a unique name.</td></tr>
<tr><td>ComBox type</td><td>This text field shows the Type of the connected ComBox.

There are two types of a ComBox:
Leica ComBox10
Leica ComBox20</td></tr>
<tr><td>Integrated MonBox</td><td>If a Leica MonBox is integrated in the ComBox, then select the radio button "Yes".

Per default the radio button "No" is selected.

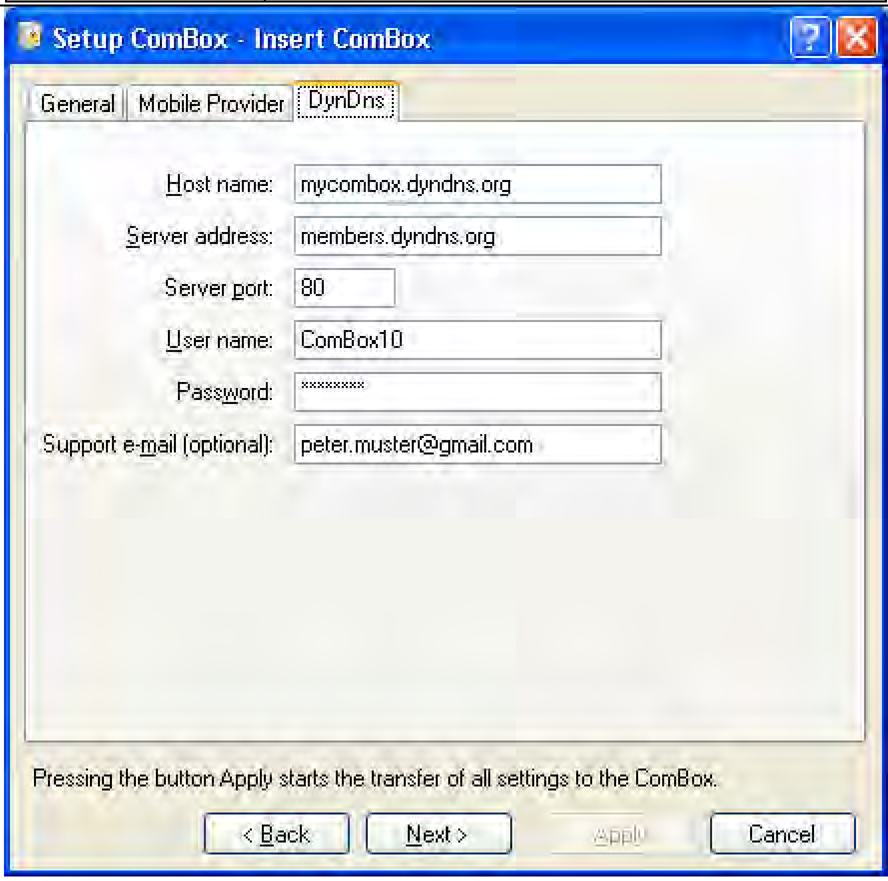
This information is important when you would</td></tr>
</table>

</td></tr>
</table>

	like to send SMS over a ComBox. **Sending SMS over a ComBox** is only possible when a MonBox is integrated in the ComBox and the radio button "Yes" is selected. Refer to the Message Configurator how to configure the SMS settings.
Comment (optional)	This text field gives you the opportunity to define a comment for the ComBox (e.g. what sensors will be connected to this ComBox). **Note:** This text field is only available if the ComBox will be configured via the ComBox Manager in GeoMoS. (To insert a break line in the text field, press Ctrl + CR key.)
< Back	Press this button to get one register back in the wizard.
Next >	Press this button to get to the next register in the wizard.
Apply	Press the button **Apply** to start the transfer of all settigns to the ComBox. **Note:** Not till all appropriate settings are set in the wizard you can start the transfer.
Cancel	Press this button to close the wizard and get back to the previous ComBox Manager dialog. **Note:** The made changes in the wizard will be lost and the settings will be not transferred to the ComBox.

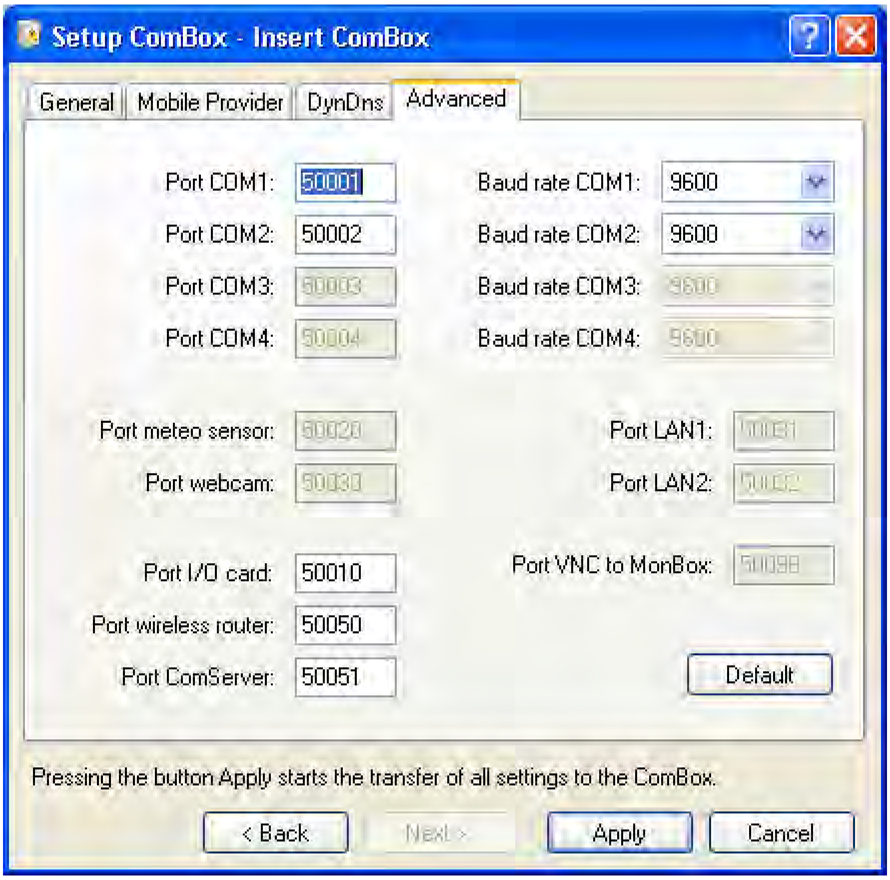
Mobile Provider

Field/Button	Description
Phone number	Set the phone number that is to dial. This may be a **GPRS/UMTS breakout number** such as ***99***1#** or a standard telephone number from your mobile provider. Per default the number ***99***1#** is set.
User name	Enter an **User name**. Get this information from your mobile provider. **Note:** This text field can be void.
Password	Enter a **Password**. Get this information from your mobile provider. **Note:** This text field can be void.
Access point name	Enter an **Access point name**. Get this information from your mobile provider.
Authentication method	Select the Authentication method. Use the Challenge Handshake Authentication Protocol (**CHAP**) or the Password Authentication Protocol

		(**PAP**)
	PPP DNS query	Specifies wether a DNS request (**Point-to-Point Protocol DNS query**) to the mobile provider is made or not.
	< Back	Press this button to get one register back in the wizard.
	Next >	Press this button to get to the next register in the wizard.
	Apply	Press the button **Apply** to start the transfer of all settigns to the ComBox. **Note:** Not till all appropriate settings are set in the wizard you can start the transfer.
	Cancel	Press this button to close the wizard and get back to the previous ComBox Manager dialog. **Note:** The made changes in the wizard will be lost and the settings will be not transferred to the ComBox.
DynDNS		

Field/Button	Description
Host name	Enter the host name (DynDNS name, URL) under which the ComBox will be available, e.g. myComBox.dyndns.org
Server address	Enter the server address of the Dynamic DNS Server, normally **members.dyndns.org** is used.
Server port	Enter the TCP port of the Dynamic DNS Server, normally **80** or **8245**.
User name	Enter the **User name** of your **DynDNS account**.
Password	Enter the **Password** of your **DynDNS account**.
Support e-mail (optional)	Enter an optional **Support e-mail address**.
< Back	Press this button to get one register back in the wizard.
Next >	Press this button to get to the next register in the wizard.
Apply	Press the button **Apply** to start the transfer of all settigns to the ComBox. **Note:** Not till all appropriate settings are set in the wizard you can start the transfer.
Cancel	Press this button to close the wizard and get back to the previous ComBox Manager dialog. **Note:** The made changes in the wizard will be lost and the settings will be not transferred to the ComBox.

Advanced



Field/Button	Description
Ports COM1 to COM4	Set the appropriate **COM port numbers** of the ComBox. Per default: ▪ Port COM1: 50001 ▪ Port COM2: 50002 ▪ Port COM3: 50003 (ComBox20 only) ▪ Port COM4: 50004 (ComBox20 only)
Baud rates COM1 to COM4	Select in the list box the baud rates for each COM port. Following baud rates are available: ▪ 4800 ▪ 9600 ▪ 1920 0 ▪ 1152 00 **Note:** To select the baud rates a **LAN**

			connection to the ComBox is required. If the ComBox is connected via Internet, then the list boxes with the baud rates are hidden. Make sure that your chosen baud rates match to the baud rates of the instruments which will be connected to the COM ports of the ComBox.
		Port meteo sensor	Set the appropriate **meteo sensor port number (ComBox20 only)** of the ComBox. Per default: 50020
		Port webcam	Set the appropriate **webcam port number (ComBox20 only)** of the ComBox. Per default: 50030 **Note:** When you connect a webcam powered over Ethernet (PoE) to the ComBox20 via a LAN port of the unmanaged Ethernet switch, the IP address of the webcam must be **192.168.1.30**. Otherwise you are not able to communicate with the webcam over mobile Internet.
		Port LAN1	Set the appropriate **LAN1 port number (ComBox20 only)** of the ComBox. Per default: 50031 **Note:** When you connect a IP device powered over Ethernet (PoE) to the ComBox20 via a LAN port of the unmanaged Ethernet switch, the IP address of the device must be **192.168.1.31**. Otherwise you are not able to communicate with the IP device over mobile Internet.
		Port LAN2	Set the appropriate **LAN2 port number (ComBox20 only)** of the ComBox. Per default: 50032 **Note:** When you connect a IP device powered over Ethernet (PoE) to the ComBox20 via a LAN port of the unmanaged Ethernet switch, the IP

		address of the device must be **192.168.1.32**. Otherwise you are not able to communicate with the IP device over mobile Internet.
	Port I/O card	Set the appropriate **I/O port number** of the ComBox. Per default: 50010
	Port wireless router	Set the appropriate **wireless router port number** of the ComBox. Per default: 50050
	Port ComServer	Set the appropriate **ComServer port number** of the ComBox. Per default: 50051
	Port VNC to MonBox	Set the appropriate **VNC to MonBox port number** of the ComBox. Per default: 50098 **Note:** The text field is only active if in the register General an integrated MonBox is selected.
	Default	Press this button to set the **default values** in all text fields.
	< Back	Press this button to get one register back in the wizard.
	Next >	Press this button to get to the next register in the wizard.
	Apply	Press the button **Apply** to start the transfer of all settigns to the ComBox. **Note:** Not till all appropriate settings are set in the wizard you can start the transfer.
	Cancel	Press this button to close the wizard and get back to the previous ComBox Manager dialog. **Note:** The made changes in the wizard will be lost and the settings will be not transferred to the ComBox.

ComBox - View Settings

Background information

The **View Settings** dialog gives you an quick overview of all settings which are assigned to the selected ComBox without establishing a connection to this ComBox.

The "View Settings" dialog is divided in four parts:

- **General**: General settings (e.g. ComBox name, type, etc.)
- **Mobile Provider**: Settings from the mobile provider (e.g. phone number, login data, access point name, etc.)
- **DynDNS**: Settings from the DynDNS account (host name, server address, login data, etc.)
- **Advanced**: Port numbers

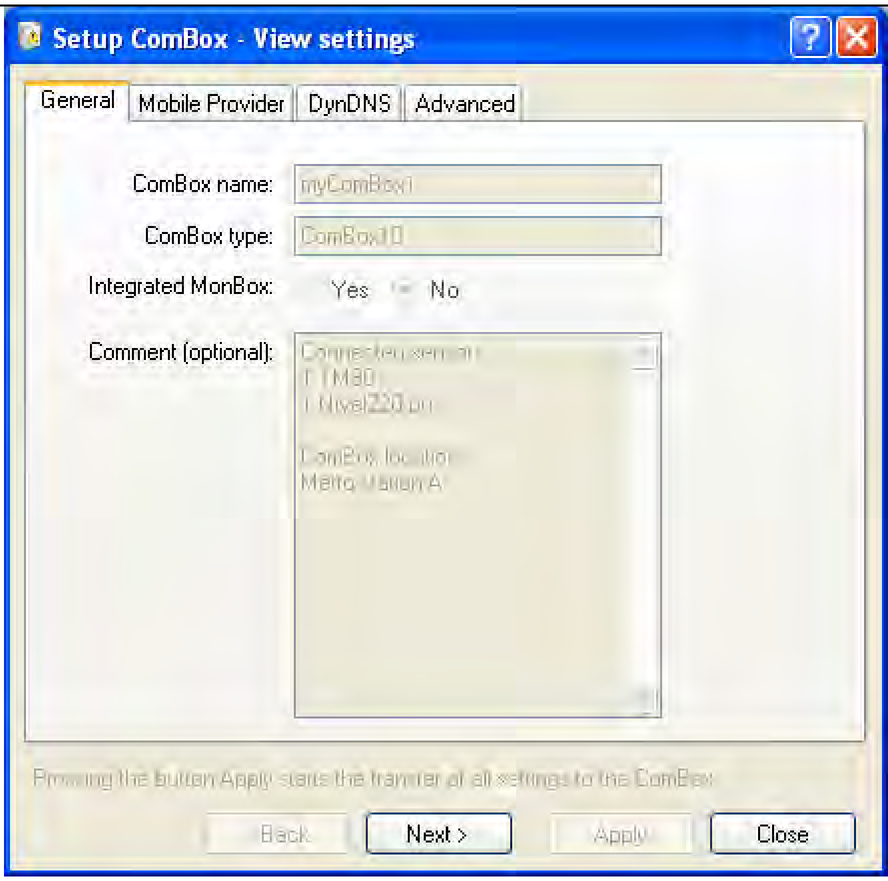
Note:

- There is no connection to the appropriate ComBox required. The "View settings" dialog will just display the stored settings in GeoMoS.
- In the register Advanced there are only the port numbers displayed.
- It is not possible to edit any settings in this dialog.
- To open the View Settings dialog, please follow the instructions on the page **ComBox Manager - Overview**.

For more details about each register, please refer to the page **ComBox - Configuration**.

Procedure

Follow these steps to view the settings of a selected ComBox.

Step/Register	Action
General	

Field/Button	Description of the displayed settings
ComBox name	Text field with the **Name** of the ComBox.
ComBox type	This text field shows the **Type** of the connected ComBox. There are two types of a ComBox: ▪ Leica ComBox10 ▪ Leica ComBox20
Integrated MonBox	Shows the status if a **Leica MonBox** is integrated in the ComBox or not.

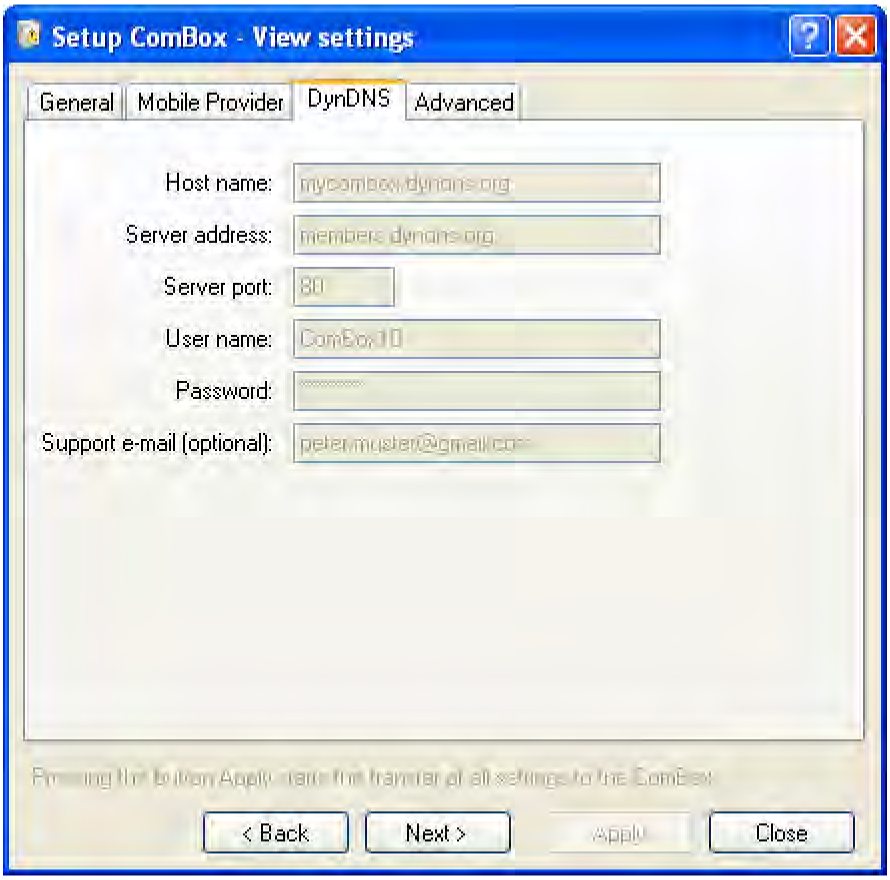
Comment (optional)	This text field displays the inserted comment (e.g. what sensors are connected to this ComBox).
< Back	Press this button to get one register back in the wizard.
Next >	Press this button to get to the next register in the wizard.
Apply	The button **Apply** in this dialog is always inactive due to it is not possible to edit any settings.
Close	Press this button to close the wizard and get back to the previous ComBox Manager dialog.

Mobile Provider

Field/Button	Description of the displayed settings
Phone number	Text field with the entered phone number that is to dial. This may be a **GPRS/UMTS breakout number** such as ***99***1#** or a standard

	telephone number from your mobile provider. Per default the number ***99***1#** is set.
User name	Text field with the entered **User name**. Get this information from your mobile provider. **Note:** This text field can be void.
Password	Text field with the entered **Password**. Get this information from your mobile provider. **Note:** This text field can be void.
Access point name	Text field for the **Access point name**. Get this information from your mobile provider.
Authentication method	List box which displays the selected Authentication method. Challenge Handshake Authentication Protocol (**CHAP**) or the Password Authentication Protocol (**PAP**)
PPP DNS query	This check box specifies wether a DNS request (**Point-to-Point Protocol DNS query**) to the mobile provider is made or not.
< Back	Press this button to get one register back in the wizard.
Next >	Press this button to get to the next register in the wizard.
Apply	The button **Apply** in this dialog is always inactive due to it is not possible to edit any settings.
Close	Press this button to close the wizard and get back to the previous ComBox Manager dialog.

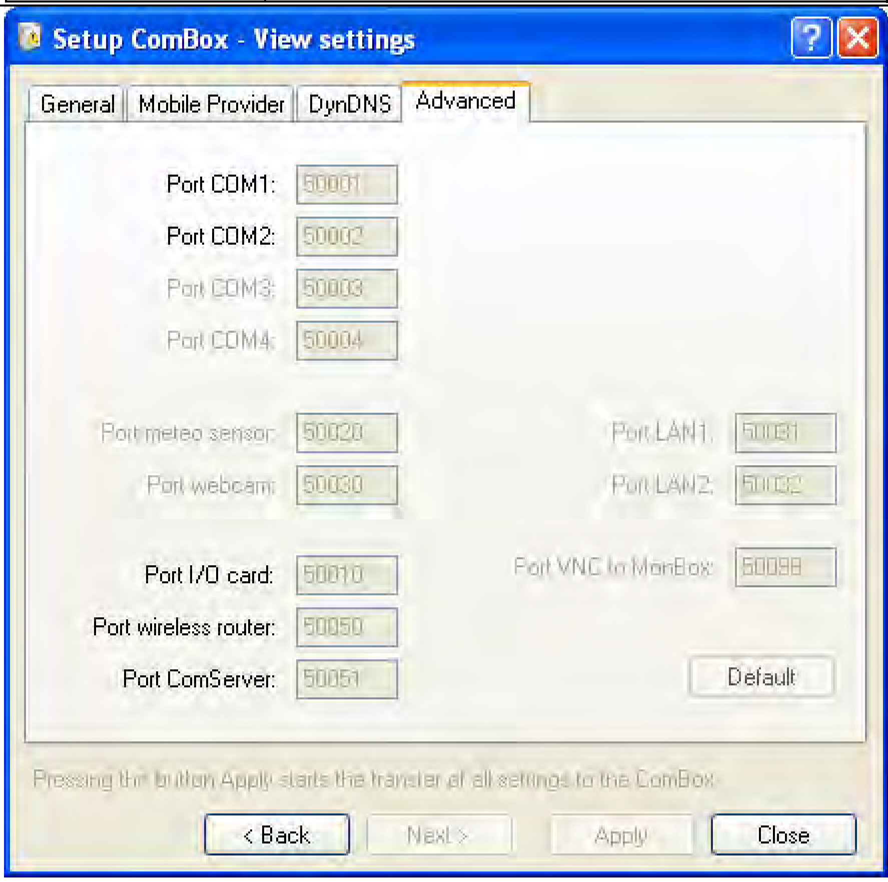
DynDNS



Field/Button	Description of the displayed settings
Host name	Text field with the entered host name (**DynDNS name**, URL) under which the ComBox will be available, e.g. myComBox.dyndns.org
Server address	Text field with the entered server address of the Dynamic DNS Server, normally **members.dyndns.org** is used.
Server port	Text field with the entered TCP port of the Dynamic DNS Server, normally **80** or **8245**.
User name	Text field with the entered **User name** of your **DynDNS account**.
Password	Text field with the entered **Password** of your **DynDNS account**.
Support e-mail (optional)	Text field with entered **Support e-mail address**.

	Press this button to get one register back in the wizard.
	Press this button to get to the next register in the wizard.
	The button **Apply** in this dialog is always inactive due to it is not possible to edit any settings.
	Press this button to close the wizard and get back to the previous ComBox Manager dialog.

Advanced



Field/Button	Description of the displayed settings
Ports COM1 to COM4	Text fields with the entered **COM port numbers** of the ComBox. Per default: ▪ Port COM1: 50001 ▪ Port COM2: 50002 ▪ Port COM3: 50003 (ComBox20 only)

	▪ Port COM4: 50004 (ComBox20 only)
Port meteo sensor	Text field with the entered **meteo sensor port number (ComBox20 only)** of the ComBox. Per default: 50020
Port webcam	Text field with the entered **webcam port number (ComBox20 only)** of the ComBox. Per default: 50030
Port LAN1	Text field with the entered **LAN1 port number (ComBox20 only)** of the ComBox. Per default: 50031
Port LAN2	Text field with the entered **LAN2 port number (ComBox20 only)** of the ComBox. Per default: 50032
Port I/O card	Text field with the entered **I/O port number** of the ComBox. Per default: 50010
Port wireless router	Text field with the entered **wireless router port number** of the ComBox. Per default: 50050
Port ComServer	Text field with the entered **ComServer port number** of the ComBox. Per default: 50051
Port VNC to MonBox	Text field with the entered **VNC to MonBox port number** of the ComBox. Per default: 50098
Default	The button Default in this dialog is always inactive due to it is not possible to edit any settings.
< Back	Press this button to get one register back in the wizard.
Next >	Press this button to get to the next register in the wizard.
Apply	The button **Apply** in this dialog is always inactive due to it is not possible to edit any settings.
Close	Press this button to close the wizard and get back to the previous ComBox Manager dialog.

ComBox - Test Link

Background information

The **Test Link** process tests:

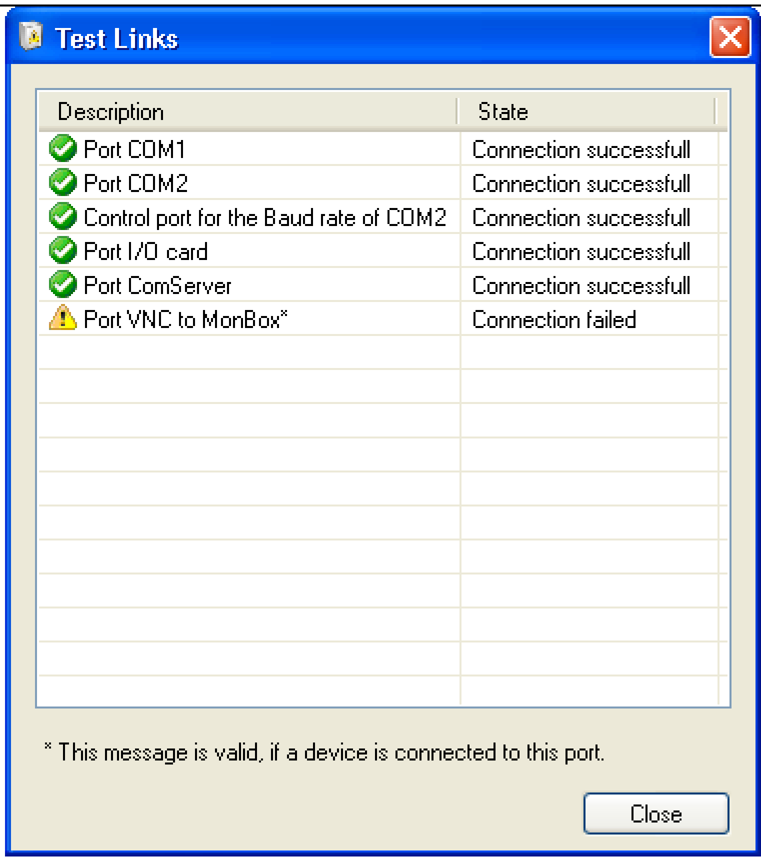
- the connection to the selected ComBox and
- all its included modules (respectively the ports of the modules).

Note:

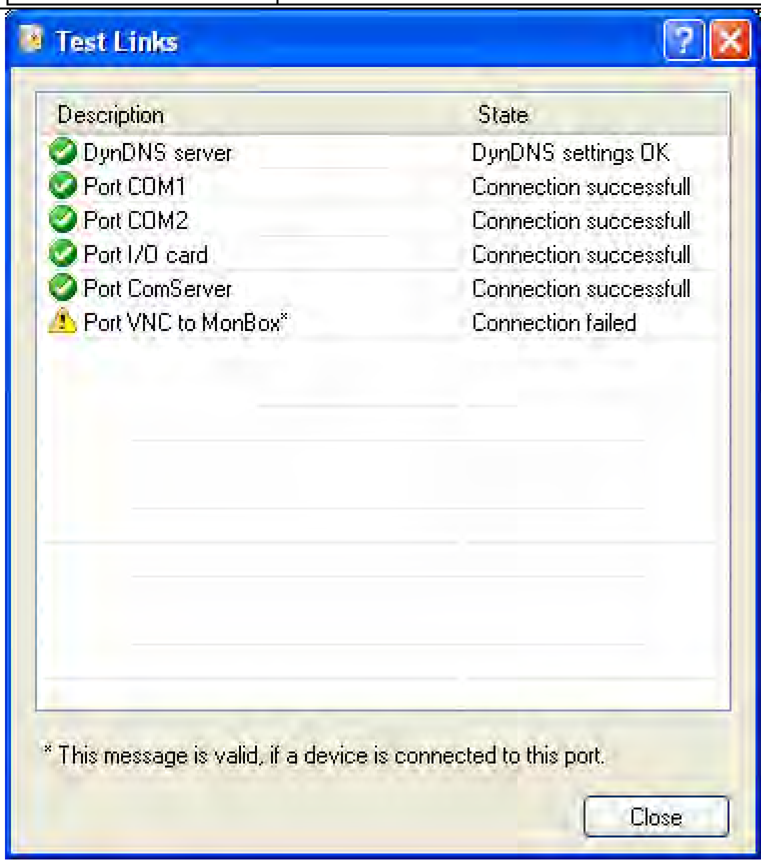
- This test can be only executed if the selected ComBox is physically connected via an Ethernet cable or Internet to the computer where the ComBox Manager is running.
- To open the Test Link dialog, please follow the instructions on the page **ComBox Manager - Overview**.

Procedure

Depending on the ComBox type and the connection type (LAN or Internet) the Test Link process differs in the tested modules:

<table>
<tr><th>ComBox / Connection Type</th><th>Description of the tested modules</th></tr>
<tr><td>ComBox10 / LAN</td><td>


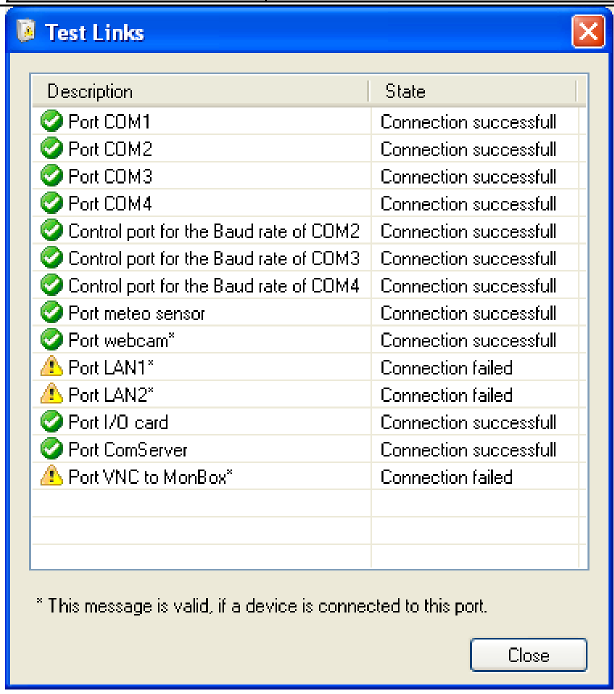
<table>
<tr><th>Module/Port</th><th>Possible States</th></tr>
<tr><td>Port COM1</td><td>Connection successfull (The port is open)
Connection failed (There is a problem with the wireless router)</td></tr>
<tr><td>Port COM2</td><td>Connection successfull (The port is open)
Connection failed (There is a problem with the ComServer)</td></tr>
</table>
</td></tr>
</table>

	Control port for the Baud rate of COM2	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the ComServer)
	Port I/O card	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the I/O card)
	Port ComServer	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the ComServer)
	Port VNC to MonBox*	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the MonBox) **Note:** The message (state) is only valid, if a MonBox is connected to this port.
		Press this button to close the dialog and get back to the previous ComBox Manager dialog.
ComBox10 / Internet		

Description Module/Port	Possible States
DynDNS server	▪ DynDNS settings OK (Connection to DynDNS server was successfull and the settings are correct.) ▪ Connectiong to DynDNS server failed (Either your DynDNS server address or your DynDNS server port is not valid. Please verify your DynDNS settings.) ▪ Resolving ComBox Host name failed (Your Host name (DynDNS name) is not valid. Please verify your DynDNS settings.) ▪ Setting an IP address on DynDNS server failed. **Note:** If there is a problem with the DynDNS settings, please check firstly these settings in the register DynDNS of the ComBox Setup wizard, secondly check if there is a Internet connection and , if there are still problems, thirdly reboot the ComBox.
Port COM1	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the wireless router)
Port COM2	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the ComServer)
Port I/O card	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the I/O card)
Port ComServer	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the ComServer)
Port VNC to	▪ Connection successfull (The port is open)

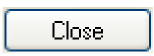
MonBox*	▪ Connection failed (There is a problem with the MonBox) **Note:** The message (state) is only valid, if a MonBox is connected to this port.
	Press this button to close the dialog and get back to the previous ComBox Manager dialog.

ComBox20 / LAN

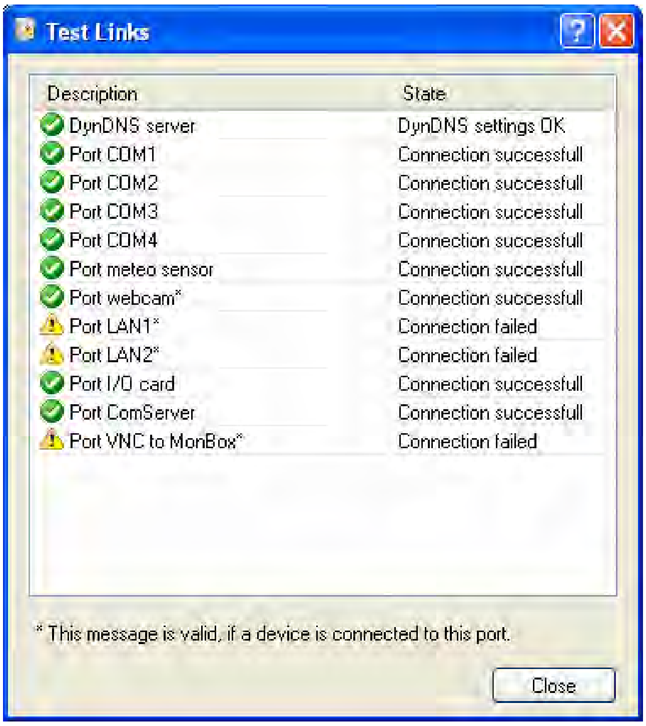


Description Module/Port	**Possible States**
Port COM1	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the wireless router)
Port COM2	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the ComServer)
Port COM3	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the ComServer)
Port COM4	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with

	the ComServer)
Control port for the Baud rate of COM2	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the ComServer)
Control port for the Baud rate of COM3	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the ComServer)
Control port for the Baud rate of COM4	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the ComServer)
Port meteo sensor	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the meteo module)
Port webcam	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the webcam) **Note:** ▪ When you connect a webcam powered over Ethernet (PoE) to the ComBox20 via a LAN port of the unmanaged Ethernet switch, the IP address of the webcam must be **192.168.1.30**. Otherwise you are not able to communicate with the webcam. ▪ The message (state) is only valid, if a webcam (PoE) is connected to this port.
Port LAN1	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the IP device) **Note:** ▪ When you connect a IP device powered over Ethernet (PoE) to the ComBox20 via a LAN port of the unmanaged Ethernet switch, the IP address of the device must be

	192.168.1.31. Otherwise you are not able to communicate with the IP device. ▪ The message (state) is only valid, if a IP device is connected to this port.
Port LAN2	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the IP device) **Note:** ▪ When you connect a IP device powered over Ethernet (PoE) to the ComBox20 via a LAN port of the unmanaged Ethernet switch, the IP address of the device must be **192.168.1.32**. Otherwise you are not able to communicate with the IP device. ▪ The message (state) is only valid, if a IP device is connected to this port.
Port I/O card	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the I/O card)
Port ComServer	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the ComServer)
Port VNC to MonBox*	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the MonBox) **Note:** The message (state) is only valid, if a MonBox is connected to this port.
	Press this button to close the dialog and get back to the previous ComBox Manager dialog.

ComBox20 / Internet



Description Module/Port	Possible States
DynDNS server	▪ DynDNS settings OK (Connection to DynDNS server was successfull and the settings are correct.) ▪ Connectiong to DynDNS server failed (Either your DynDNS server address or your DynDNS server port is not valid. Please verify your DynDNS settings.) ▪ Resolving ComBox Host name failed (Your Host name (DynDNS name) is not valid. Please verify your DynDNS settings.) ▪ Setting an IP address on DynDNS server failed. **Note:** If there is a problem with the DynDNS settings, please check firstly these settings in the register DynDNS of the ComBox Setup wizard, secondly check if there is a Internet connection and , if there are still problems, thirdly reboot the ComBox.
Port COM1	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with

	the wireless router)
Port COM2	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the ComServer)
Port COM3	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the ComServer)
Port COM4	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the ComServer)
Port meteo sensor	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the meteo module)
Port webcam*	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the webcam) **Note:** ▪ When you connect a webcam powered over Ethernet (PoE) to the ComBox20 via a LAN port of the unmanaged Ethernet switch, the IP address of the webcam must be **192.168.1.30**. Otherwise you are not able to communicate with the webcam. ▪ The message (state) is only valid, if a webcam (PoE) is connected to this port.
Port LAN1*	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the IP device) **Note:** ▪ When you connect a IP device powered over Ethernet (PoE) to the ComBox20 via a LAN port of the unmanaged Ethernet

	switch, the IP address of the device must be **192.168.1.31**. Otherwise you are not able to communicate with the IP device. ▪ The message (state) is only valid, if a IP device is connected to this port.
Port LAN2*	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the IP device) **Note:** ▪ When you connect a IP device powered over Ethernet (PoE) to the ComBox20 via a LAN port of the unmanaged Ethernet switch, the IP address of the device must be **192.168.1.32**. Otherwise you are not able to communicate with the IP device. ▪ The message (state) is only valid, if a IP device is connected to this port.
Port I/O card	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the I/O card)
Port ComServer	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the ComServer)
Port VNC to MonBox*	▪ Connection successfull (The port is open) ▪ Connection failed (There is a problem with the MonBox) **Note:** The message (state) is only valid, if a MonBox is connected to this port.
	Press this button to close the dialog and get back to the previous ComBox Manager dialog.

ComBox - Test Digital Out

Background information

The **Test Digital Out** dialog displays the state of the Digital I/O outputs of the selected ComBox.

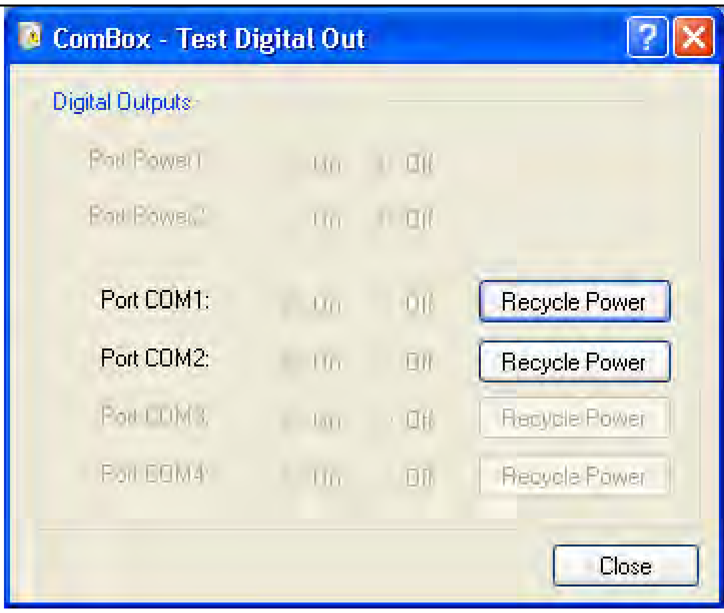
The dialog gives also the opportunity to recycle the power of the appropriate COM ports.

Note:

- This test can be only executed if the selected ComBox is physically connected via an Ethernet cable or Internet to the computer where the ComBox Manager is running.
- To open the Test Digital Out dialog, please follow the instructions on the page **ComBox Manager - Overview**.

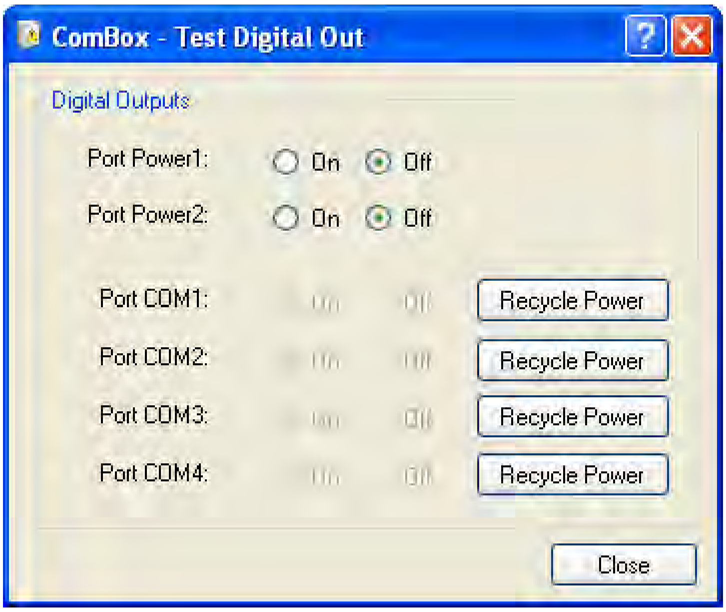
Procedure

Depending on the ComBox type the Test Digital Out dialog differs in the display of the number of digital outputs:

ComBox type	**Description of the Test Digital Out dialog**
ComBox10	

Field/Button	Description
Port Power1:	▪ Inactive ▪ Only available for ComBox20
Port Power2	▪ Inactive ▪ Only available for ComBox20
Port COM1	▪ Displays the state of port COM1: On or Off ▪ Possibility to recycle the power with the button Recycle Power (This action will switch off and on this port within two seconds respectively the connected instrument.) ▪ This test gives you the opportunity to check if the instrument is connected correctly.
Port COM2	▪ Displays the state of port COM2: On or Off ▪ Possibility to recycle the power with the button Recycle Power (This action will switch off and on this port within two seconds respectively the connected instrument.) ▪ This test gives you the opportunity to check if the instrument is connected correctly.
Port COM3	▪ Inactive ▪ Only available for ComBox20
Port COM4	▪ Inactive ▪ Only available for ComBox20
Recycle Power	Press this button to recycle the power of the appropriate COM port. Within two seconds the port will be switched off and on. This action gives you the opportunity to check if a connected instrument to the ComBox is connected correctly.
Close	Press this button to close the dialog and get back to the previous ComBox Manager dialog.

ComBox20



Field/Button	Description
Port Power1:	▪ Displays the state of port Power1 ▪ The active radio buttons On/Off allows to switch on and off this port manually. ▪ Only available for ComBox20
Port Power2	▪ Displays the state of port Power2 ▪ The active radio buttons On/Off allows to switch on and off this port manually. ▪ Only available for ComBox20
Port COM1	▪ Displays the state of port COM1: On or Off ▪ Possibility to recycle the power with the button Recycle Power (This action will switch off and on this port within two seconds respectively the connected instrument.) ▪ This test gives you the opportunity to check if the instrument is connected correctly.
Port COM2	▪ Displays the state of port COM2: On or Off ▪ Possibility to recycle the power with the button Recycle Power (This action will switch off and on this port within two seconds respectively the connected instrument.) ▪ This test gives you the opportunity to check if

	the instrument is connected correctly.
Port COM3	▪ Displays the state of port COM3: On or Off ▪ Possibility to recycle the power with the button Recycle Power (This action will switch off and on this port within two seconds respectively the connected instrument.) ▪ This test gives you the opportunity to check if the instrument is connected correctly. ▪ Only available for ComBox20
Port COM4	▪ Displays the state of port COM4: On or Off ▪ Possibility to recycle the power with the button Recycle Power (This action will switch off and on this port within two seconds respectively the connected instrument.) ▪ This test gives you the opportunity to check if the instrument is connected correctly. ▪ Only available for ComBox20
Recycle Power	Press this button to recycle the power of the appropriate COM port. Within two seconds the port will be switched off and on. This action gives you the opportunity to check if a connected instrument to the ComBox is connected correctly.
Close	Press this button to close the dialog and get back to the previous ComBox Manager dialog.

Sensor Manager

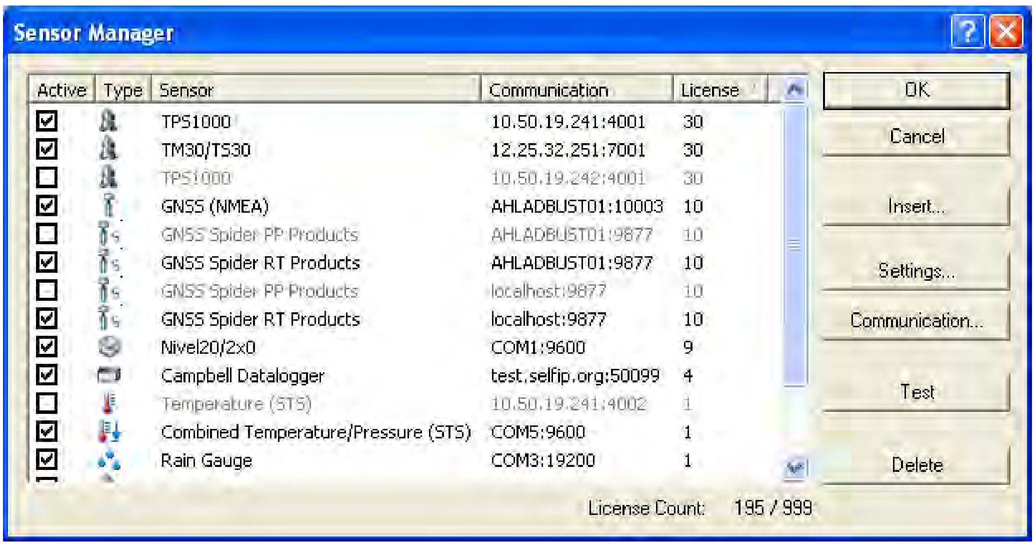
Sensor Manager

Topic contents

Open the Sensor Manager

- Select from the menu **Configuration**, **Sensor Manager...** or click the toolbar **Sensor Manager button** 

The **Sensor Setup** dialog is displayed.



The table below describes the fields and buttons in the Sensor Manager dialog box.

Field/Button	Description
Active	This check box is used to activate/deactivate sensors. Only active sensors will be available for measurement and counted for Sensor Licenses.
Type	This column displays an icon symbol for each sensor type.  Total station  GNSS NMEA sensor  GNSS Spider Positioning Product (RT or PP Positioning Product)  Leica Disto  Water level  Leica Nivel 20/200  Humidity sensor  Temperature sensor  Combined temperature/pressure  Pressure sensor  Rain gauge  Combined temperature/pressure/humidity sensor

	 Leica DNA and Sprinter Level  Campbell Scientific datalogger
Sensor	This column displays the type of sensor. Right-mouse click to modify the type of sensor. Refer to Supported Sensors for more information on sensor types.
Communication	This column displays the defined communication type. ▪ Com port or ▪ TCP/IP connection (with IP address and port)
License Count	The required amount of Sensor Licenses per sensor or bus system. The total amount of ***used*** and ***purchased/activated*** Sensor Licenses will be listed at the bottom. Example: **Licenses Count**: 31 / 100 If multiple Local Clients connect to a common Local License Server then the total amount of available Sensor Licenses for all Local Clients will be listed in brackets. Example: Local Client A with project A: **Licenses Count**: 31 / 100 (70); Local Client B with project B: **Licenses Count**: 30 / 100 (69) ▪ 31 Sensor Licenses (TPS and Meteo sensor) are ***used*** in the "project A" ▪ 100 Sensor Licenses is the total amount of ***purchased and activated*** Sensor Licenses on this Local Licenses Server ▪ (70) Sensor Licenses is the total amount of ***available*** Sensor Licenses on this Local Licenses Server for the "project A"
	Press **Insert...** to insert a new sensor. A list box with all available sensor types appears. Select the type of sensor you wish to connect. Refer to Supported Sensors for more information on sensor types.

	Right-mouse click on an inserted sensor to modify the sensor type. After modifying the sensor type the sensor specific settings must be applied.
Settings...	Select a sensor and press **Settings...** to define / edit the sensor settings. Define the settings such as the name, description, control point and other sensor dependant settings for the currently selected sensor. See Sensor Settings below more detailed setting information. The following sensors have additional or different settings: • Total stations • GNSS Spider RT Positioning Products and PP Positioning Products • Nivel20/200 • Campbell Datalogger
Communication...	Select a sensor and press **Communication...** to define / edit the sensor communication configuration that is used to connect to the sensor for the currently selected sensor. Define the communication options such as communication type, communication channel, baud rate, IP address and port. ▪ Connection channel: Select the Com port or TCP/IP ▪ Baud rate (only COM): Select the defined baud rate ▪ IP address (only TCP/IP): Enter the IP address or host name ▪ Port (only TCP/IP): Enter the port number ▪ Password (only Spider connections): Enter the Spider Site server password. Communication types: ▪ Not specified ▪ LAN/Cable ▪ Radio Link

	▪ Internet/WAN ▪ Mobile Link (GPRS/UMTS) Select the type of communication you physical in use. The selected communication defines limits for round-trip delay and various communication time outs. Note: ▪ For the Web-Thermo-Hygrobarograph sensor the port is fixed to 80. ▪ The list boxes for the IP address and the port number are available if you have configured ComBoxes in the ComBox Manager. Instead of typing in the appropriate IP address and port number you can select them in the list box.
Test	Use this button to test the communication to the currently selected sensor.
Delete	Press **Delete** to remove the currently selected sensor. All sensor settings (database links) will be lost.

Sensor Settings

The Sensor Settings (Sensor Parameter) dialog depends on the selected sensor. All sensors have the following settings:

Setting	Description
Sensor Name	Enter the name of this individual sensor.
Sensor Description	Enter the description of this sensor or its location.
Sensor Location	Choose the instrument control point. If the point is not yet defined use the **Points** button to switch to the Point Editor to create the instrument stand point.

The following sensors have additional or different settings:

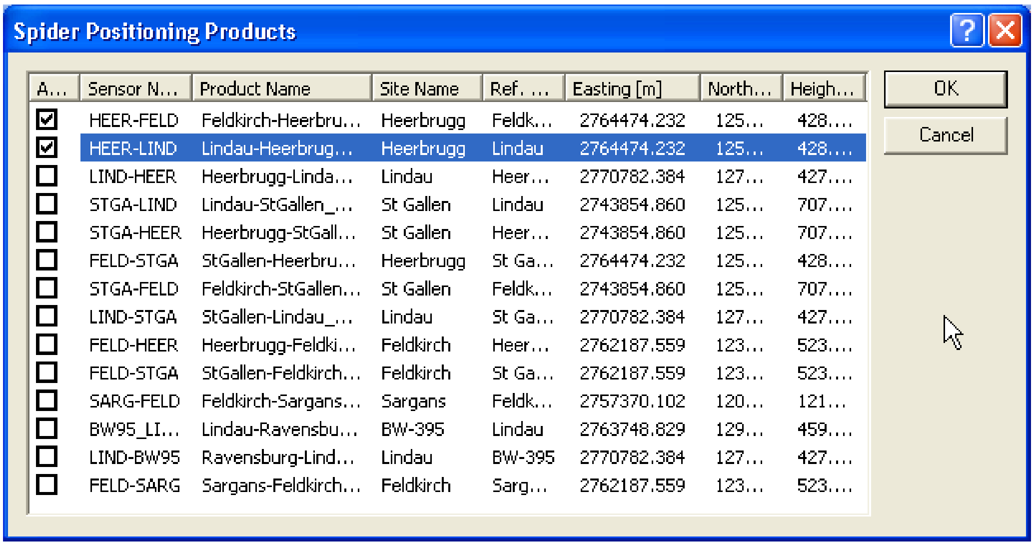
Total Station

<table>
<tr><th>Setting</th><th>Description</th></tr>
<tr><td>Model</td><td>Select the appropriate total station model for the connected sensor.</td></tr>
<tr><td>Compensator ON</td><td>Turns the compensator in the total station on. The compensator is used to correct for mislevelling of the instrument and is required for high accuracy angle measurement. It should only be turned of if angles are not measured or if external effects (such as vibration from nearby heavy machinery) prevents the compensator from working correctly.

Note: A mislevelling of the compensator outside the total station compensator...
... specification may causes lower accurate compensation of the angle measurement.
... working range causes in GeoMoS Monitor the message "Point not found".
The total station compensator specification can be checked with the Tolerance.</td></tr>
<tr><td>Laserpointer ON</td><td>Turns the visible light laser pointer on to show where the instrument is pointing. This option is only available with total stations that support reflectorless mode.</td></tr>
<tr><td>Beep</td><td>If this option is activated the instrument will beep when it performs certain tasks or encounters errors.</td></tr>
</table>

GNSS Spider RT Positioning Products and PP Positioning Products

A list of all active RT Positioning Products or PP Positioning Products configured in Leica GNSS Spider and with results sent to Leica GeoMoS will be shown.

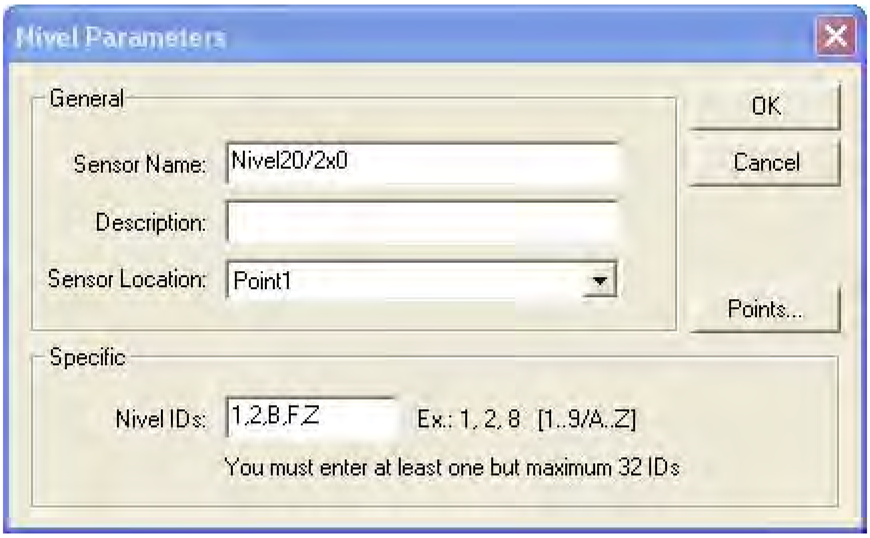


Field/Button	Description
Active	This check box is used to activate/deactivate GNSS Spider Products. Only active products will be available for measurement.
Sensor Name	You can enter a name of this individual sensor. As default the Sensor Name is composed of SiteName_ReferenceName_PP_SpiderProductID_ComputerID.
Product Name	The Product Name configured in GNSS Spider.
Site Name	The used Site configured in GNSS Spider for this baseline.
Reference Name	The used Reference configured in GNSS Spider for this baseline.
Easting, Northing, Height	The transferred initial site coordinate in GNSS Spider for this baseline. The coordinates configured in GNSS Spider will be transformed into the monitoring coordinate system.
	Use this button to automatically create points in the **Point Editor** for all active Products. The coordinates configured in GNSS Spider will be transformed into the monitoring coordinate system and used to set the Null and other coordinate types. **Notes:** • For high accuracy monitoring applications only the GPS quality indicator level 4 (ambiguity fixed phase position) is accepted. The quality level refers to the **GPS Quality Indicator** in the NMEA GGA

	format. • Each baseline (product) can be also activated and deactivated in GNSS Spider. Only active Products are displayed in Leica GeoMoS.

Nivel20/200

Nivel IDs: Each Nivel sensor has an address ID that is configured with the Nivel configuration software that is included with the sensor. Since up to 32 Nivel sensors can be configured in serial, GeoMoS needs the ID to be able to identify individual Nivel sensors. In this field the IDs of all Nivel sensors connected to this serial port should be listed separated by commas.



Every Nivel sensor has a unique address consisting of the two characters N**x**:

- The first character is always N, the second character is alphanumerical from 0-9 and A-Z.
- 36 individual addresses are available. A maximum of 32 Nivel sensors can be connected to a data bus.

Example: 5 Nivels (N**1**, N**2**, N**B**, N**F** and N**Z**) are connected to a single serial port.

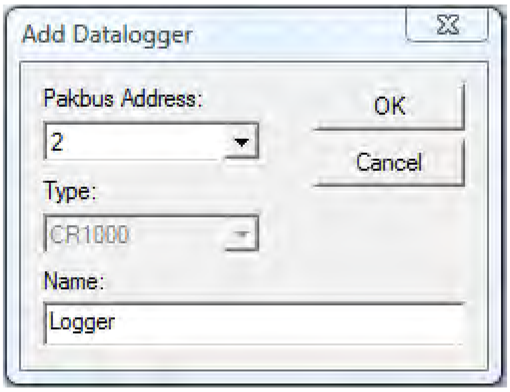
Note: Never use the Nivel address N0, because this address calls very Nivel sensor in a network.

Campbell Scientific Datalogger

The Campbell Datalogger and the connected geotechnical sensors differs slightly in the workflow from all other sensors you may use together with Leica GeoMoS because in addition a small and very simple program at the onboard measurement and control module of the Campbell Datalogger is required.

Add a Campbell Scientific Datalogger

Follow these steps to add a Campbell Scientific Datalogger.

Step	Action
1	Open the **Sensor Settings** of the Campbell Datalogger.
2	The **Campbell Datalogger Parameters** dialog will be displayed.
3	Right click on the IP address in the tree view and choose **Add Campbell Datalogger**.  Select the correct **Pakbus Address**, enter the **Datalogger Name** of the new Campbell Datalogger and continue with **OK**. The Campbell Datalogger will be shown in the tree view.
4	Right click on the Campbell Datalogger and choose **Add Datalogger Table**. Leica GeoMoS will connect to the Campbell Datalogger and read the available tables.
5	Select a **Table** from the list and define with the **read out time interval** how frequently the results of the table is read out from Leica GeoMoS.
6	The available sensors will be displayed. Repeat steps 3 through 5 for additional Campbell Dataloggers on the identical IP address with different Pakbus addresses.
7	Confirm the **Campbell Datalogger** parameters with **OK**.

8	The dialog will be closed and the new sensors will be saved in the database.

Notes:

- The **measurement interval** of the sensor is set **per table** in the measurement module on the **Campbell Datalogger**.

  If for example the measurement interval is set to 1 second and the read out time interval is set to 1 minute, GeoMoS retrieves each minute the last 60 measurements of the Campbell datalogger with the original time stamp.

- The **read out time interval** of the a datalogger table is set in the **Senor Manager**, **Campbell Datalogger Parameters** dialog and is transferred to the **Interval** field the **Measurement Cycle Editor**.

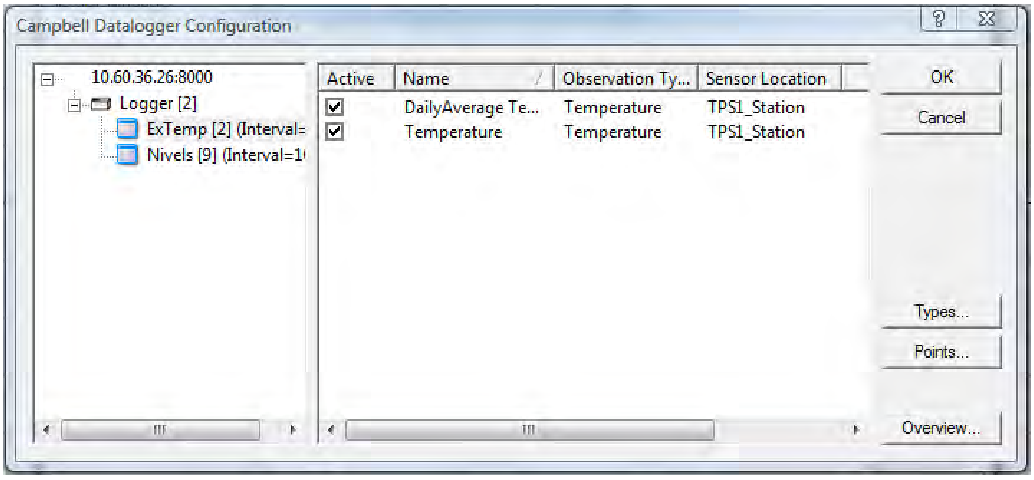
  It is only allowed to have different Intervals for different tables. Sensors in a single table cannot have different read out time intervals.

Campbell Datalogger Parameters dialog

A list of all sensors configured in the Campbell Datalogger and with results stored in the selected table on the datalogger will be shown.

Step	Action
1	Activate the required sensors of the Campbell Datalogger. Enter their appropriate Observation Type and define the Sensor Location.
2	Confirm the settings with **OK**.
3	The dialog will be closed and the new sensors will be saved in the database.

Note: The above description guided you through the creation process by describing the minimum settings only.



Field/Button	Description
Active	This check box is used to activate/deactivate sensors connected to the Campbell Datalogger. Only active sensors will be available for measurements.
Name	You can enter a name of every individual sensor connected to the Campbell Datalogger. As default the Sensor Name is transferred from the Campbell Datalogger.
Description	Enter the description of this sensor or its location.
Observation Type	Enter the observation type of the connected sensor. An observation type is mandatory even if the sensor is not active.
Sensor Location	Choose the sensor control point. A sensor location is mandatory even if the sensor is not active.
Min: / Max	Use this value to limit the sensor measurements to a minimal and/or maximum value. No measurements outside the set limits will be stored to the database. A measurement value outside the set limits causes the message "Measurement out of range" on the Messages tab.
Unit	Displays the current unit that corresponds to the selected Observation Type.
	Use this button to create additional Observation Types that can be used for the sensors connected to the Campbell Datalogger or for the virtual sensors.

Points...	If the control point is not yet defined use the **Points** button to switch to the Point Editor to create the sensor control point.
Overview...	Press this button to get an overview of the complete Campbell Datalogger configuration.
OK	Use this button to confirm all changes and decide if the clock of the attached datalogger(s) will be synchronised with the current Leica GeoMoS Monitor computer time. Note: Once a day at midnight the datalogger(s) will be automatically synchronised with the current computer time.

Context menu

With a right-click in the **Campbell Datalogger Parameter** dialog, a Context-Menu is available. A Context-Menu lists all useful commands at a particular instant for a particular item on the screen.

Menu Item	Description
Add Campbell datalogger...	Adds a Campbell Datalogger. Read above for a step-by-step description.
Add table...	Adds a table from the connected Campbell Datalogger. Read above for a step-by-step description.
Edit...	The **Pakbus Address** and the **Datalogger Name** or **read out time interval** the can be modified.
Remove	The selected Campbell datalogger or Campbell Datalogger table will be deleted from the Leica GeoMoS configuration.

Supported Sensors

A range of different sensors and sensor types are supported by GeoMoS and may be configured in the Sensor Manager.

Refer below for a list of all sensors supported by GeoMoS.

- Total Stations
- GNSS Sensors
- Inclination Sensors
- Meteo Sensors
- Levels
- Campbell Scientific Datalogger
- Geotechnical and Other Sensors

Total Stations

TPS1000 Series

The TPS1000 series of total stations from Leica Geosystems includes the following instruments:

- TCA20 03
- TCA18 00
- TM1100 + DI3000, DI3000S or DI3002 EDM
- TM1800 + DI3000, DI3000S or DI3002 EDM
- TCM1 00
- TCM1 800

Notes:

- The TCA1800 and TCA2003 are used by default in the **Precise Mode** (TCA1800 1+2ppm; TCA2003 1+1ppm). The **Standard Mode** (TCA1800 and

TCA2003 2+2ppm) and the **Fast Mode** can only be set in the Windows Registry. Please contact support for further help.

- For the TM1100 and TM1800 the Precise Mode and the Fast Mode is not available.

TPS1100 Series and TPS1100+ Series

The TPS1100 series of total stations from Leica Geosystems includes the following instruments that are supported:

- TCA1101, TCA1103, TCA1105
- TCRA1101, TCRA1103, TCRA1105

TPS1200 Series and TPS1200+ Series

The TPS1200 series and TPS1200+ series of total stations from Leica Geosystems includes the following instruments that are supported:

- all TCA models
- all TCP models
- all TCRA models
- all TCRP models
- TCA1201M for long-range monitoring (only available as TPS1200 series)

Note:

- The TCA1201M should only be used with the IR EDM modes (e.g. Distance IR, SignalScan IR). The EDM mode LO is not available.

TM30 and TS30 Series

The TM30 series and TS30 series of total stations from Leica Geosystems includes the following instruments that are supported:

- TM30 0.5"

- TM30 1"
- TS30 0.5"

GNSS Sensors

GPS (NMEA)

The GPS (NMEA) sensor is used to read in NMEA GGA format messages from a GPS sensor via a serial (COM) port. All sensors that support the NMEA GGA message are supported including the following sensors from Leica Geosystems:

- GX1230 RTK
- SR530 RTK

GPS (NMEA) TCP/IP

The GPS (NMEA) TCP/IP sensor is used to read in NMEA GGA format messages from a GPS sensor via a TCP/IP connection. All sensors that support the NMEA GGA message are supported including the above sensors from Leica Geosystems.

GNSS Spider RT Positioning Product

This sensor type is used to connect to RT Positioning Products configured in a **Leica GNSS Spider** site server. All active RT Positioning Products configured in GNSS Spider with the **Send To** option set to GeoMoS can be used in GeoMoS. Thus many GNSS sensors maybe connected using a single connection in the GeoMoS Sensor Manager to a GNSS Spider server.

GNSS Spider PP Positioning Product

This sensor type is used to connect to PP Positioning Products configured in a **Leica GNSS Spider** site server. All active PP Products configured in GNSS Spider can be used in GeoMoS. Thus many GNSS sensors maybe connected using a single connection in the GeoMoS Sensor Manager to a GNSS Spider server.

Inclination Sensors

Nivel20/200

The Nivel20 and Nivel200 are a series of highly precise inclination sensors from Leica Geosystems. The following instruments are supported

- Niv el210
- Niv el220
- Nivel20 (RS232)
- Nivel20 (RS485)

Meteo Sensors

Temperature (STS)

This sensor refers to a DTM temperature/pressure sensor from the company STS. Using this sensor type only the temperature will be read from the sensor. The STS DTM sensor may be ordered directly from Leica Geosystems with article number 667725.

Pressure (STS)

This sensor refers to a DTM temperature/pressure sensor from the company STS. Using this sensor type only the pressure will be read from the sensor. The STS DTM sensor may be ordered directly from Leica Geosystems with article number 667725.

Combined Temperature/Pressure (STS)

This sensor refers to a DTM temperature/pressure sensor from the company STS. The STS DTM sensor may be ordered directly from Leica Geosystems with article number 667725.

Note: The standard baud rate of the STS sensor is 4800.

Combined Temp/Pressure/Humidity (Reinhardt)

This sensor refers to a meteo sensor from the company Reinhardt. The Combi-Sensor DFT 1MV sensor must be ordered directly from Reinhardt.

http://www.reinhardt-testsystem.de/SENSOR.HTM

Humidity (Reinhardt)

W&T Web Temperature/Pressure/Humidity

This sensor refers to the Web-Thermo-Hygrobarograph from the company W&T. The sensor measures temperatures, relative humidity and air pressure. The sensor must be ordered directly from W&T.

http://www.wut.de/e-57612-ww-daus-000.php

Note: The standard port of the Web-Thermo-Hygrobarograph sensor is port 80.

Levels

DNA

The DNA is the high precise digital level from Leica Geosystems.

Sprinter

The Sprinter is a low cost digital level from Leica Geosystems.

Campbell Scientific datalogger

CR1000

The CR1000 datalogger can be used together with Leica GeoMoS as data acquisition system. It consists of a measurement and control module and a wiring panel. A complete system would include a power supply, weatherproof enclosure, sensors, programming/communication software and communication peripherals.

http://www.campbellsci.com/cr1000

Geotechnical and other sensors

Leica Disto

The Leica Disto is a low cost electronic distance meter from Leica Geosystems. The latest Leica Disto sensors do not support a serial interface.

Rain Gauge

This sensor refers to a meteo sensor from the company Reinhardt. The Rain/Precipitation Sensor (Ombrometer, Pluviometer) RMS 2M sensor must be ordered directly from Reinhardt.

http://www.reinhardt-testsystem.de/SENSOR.HTM

Water Level (Piezo DynaOpt)

DIMETIX Disto

The DIMETIX disto is a third party electronic distance meter from the company DIMETIX with serial interface. The sensor DLS-B sensor must be ordered directly from DIMETIX.

http://www.dimetix.com/support/EN/_FRMsupportDLSB.html

The DIMETIX sensor is connected in the **Sensor Manager** via the **Leica Disto** sensor driver. Set the following serial interface parameters:

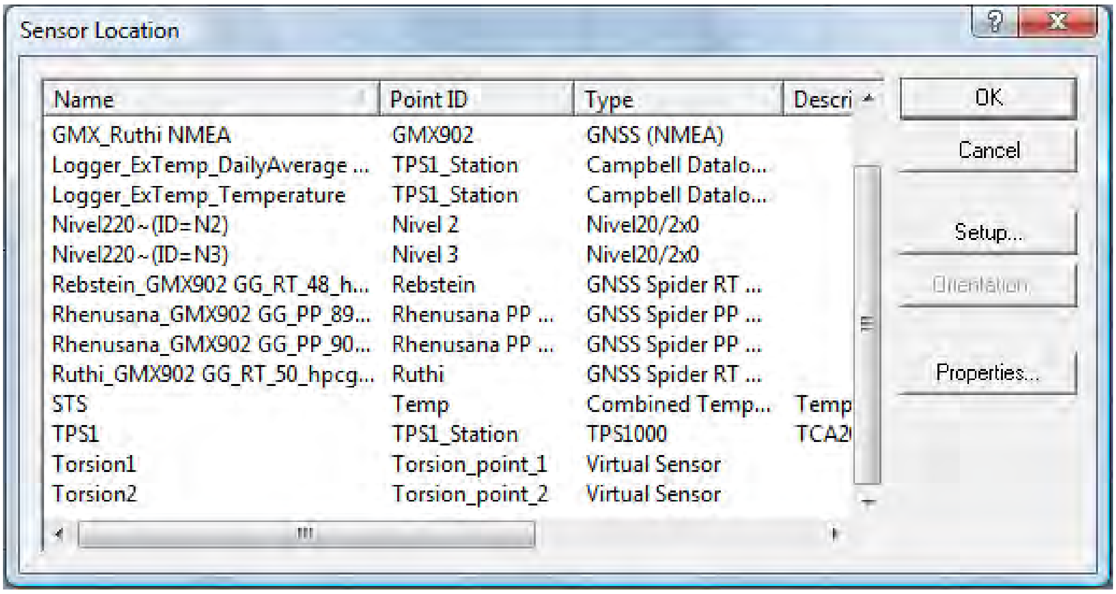
- Sensor Manager: baud rate = 19200
- Windows Registry: Databits = 7 and Parity = 2
  [HKEY_LOCAL_MACHINE\SOFTWARE\LEICA Geosystems\Leica GeoMoS\Projects\<project_name>\Sensors\GenericSensors\134217xxx]

Sensor Location Editor

Sensor Location Editor - Overview

To open the Sensor Location Editor:

Follow these steps to open the Sensor Location Editor.

Step	Action
1	Select from the menu **Configuration**, **Sensor Location Editor...** or click the toolbar **Sensor Location button** .
2	The **Sensor Location** dialog will be displayed. 
3	Select a Sensor and assign a point from the point list.
4	Change the settings as required.
5	Click the **OK** button. The **Sensor Location** dialog will be closed and the settings will be saved.

The table below describes the fields and buttons in the Sensor Location dialog box.

Field/Button	Description
Name	The name of the sensor.
Point ID	The name of the sensor control point.
Type	The sensor type.
Description	The sensor description.
Setup...	Setup is used to calculate the position of the sensor. For total stations it is possible to use a Free Station or Distance Intersection. For GNSS an average position may be calculated. See Standpoint Coordinates.
Orientation...	The orientation wizard is used to set the orientation and instrument height of the total station. See Orientation.
Properties...	The properties dialog is used to edit the calculation and measurement options for the sensor. Not all sensors have configurable properties. Refer to the list below for the properties of the different sensor types. • TPS Properties • GNSS Properties

Coordinate Calculation: Free Station

Background information

The Free Station calculation is used to determine the position of the Total Station coordinates by measuring angles and distances to control points with known coordinates.

When to use

Use the Free Station coordinate calculation

- to **determine** the initial total station control point with minimum **two known points** in a coordinate system
- after **moving** the total station **control point** to re-compute the total station coordinates

before starting the measurements.

Procedure

Follow these steps to configure the coordinate calculation - Free Station.

Step	Action
1	Select the **Setup...** button in the **Sensor Location** dialog for a total station.
2	The Free Station tab page is active.
3	Select a point from the list that will be measured for the Free Station.
4	Aim manually the total station telescope to the selected point and press the **Measure** button.
5	The measurement will be executed with the total station and the point will be listed in the **Measured Points** list. **Notes**: ▪ The selected **measurement mode** (Point Editor) for this point will be used. For example, measurement mode "ATR": The horizontal angle, vertical angle and distance will be measured.

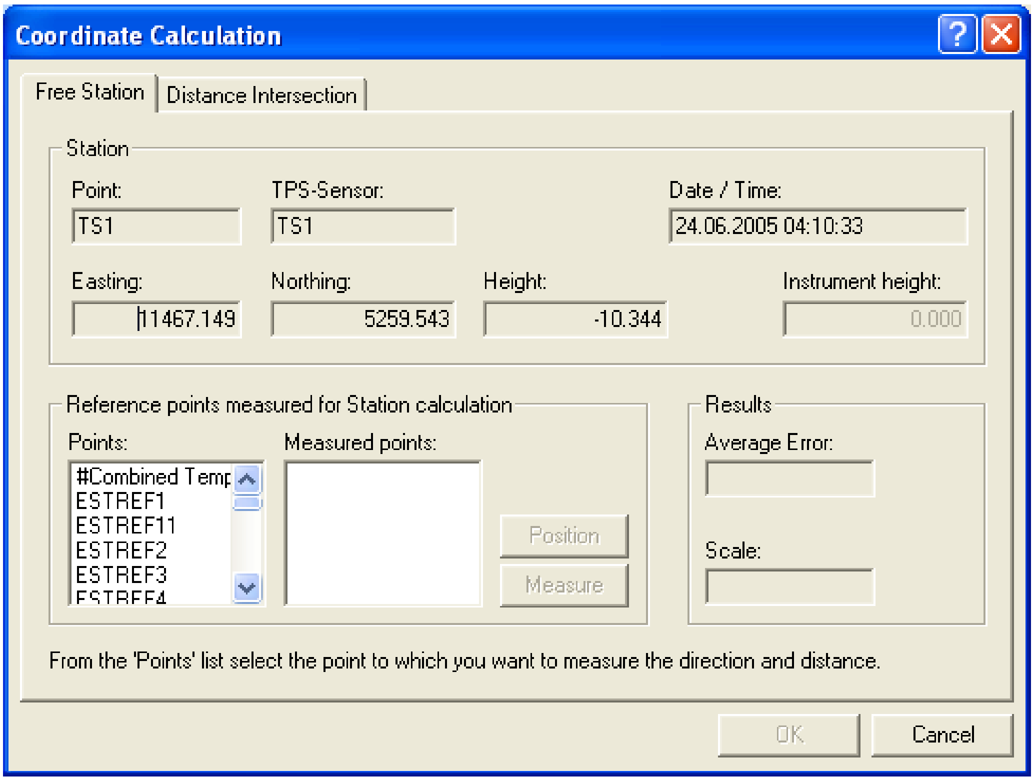
	Measurement mode "Distance IR": The distance will be measured and used for the free station computation. The angles have a low accuracy and are based on the positioning angle. ▪ **Note for TM30/TS30 only**: The **Measure** button uses the **EDM Standard** mode. The used ATR mode depends on the Windows Registry. By default the software attempts measurements in both modes, normal ATR and low visibility ATR. For example, when the normal ATR mode succeeds, the measurement is calculated directly. If due to weather conditions the normal ATR mode fails then the low visibility ATR attempts a second measurement.
6	Repeat the Step 3 to 5 for the second point.
7	Select a third point from the list. Press the **Position** button to automatically position the total station telescope to the point and then press the **Measure** button. The measurement will be executed with the total station.
8	Confirm with the **OK** button and the calculated coordinates will be saved. **Note:** The coordinate types 'Reference', 'Current', 'Scan' and 'Setup' are updated after the Sensor Location is confirmed with **OK**.
9	The **Coordinate Calculation** dialog will be closed.

When the **second** point has been measured, the Total Station coordinates will be calculated. The calculated **Coordinates** will be displayed with the **standard deviation** and the **scale factor** of the solution.

A measured point can be deleted from the calculated solution via the right mouse menu "**Delete**".

Multiple points can be measured for an over determined solution of the coordinates using least squares techniques.

The Free Station solution calculates and applies the orientation of the total station, which can be visualized in the Orientation Assistant. The calculated coordinates are not editable. The calculated coordinates are only used to manually determine the total station control point.



The table below describes the fields and buttons in the Coordinate Calculation dialog box.

Field/Button	Description
Station	
Point	The name of the Total Station control point.
TPS Sensor	The name of the sensor.
Date/time	The date/time when the point was last edited.
Easting	The easting of the Total Station control point.
Northing	The northing of the Total Station control point.
Height	The height of the Total Station control point.
Instrument height	The height of the sensor above the survey mark.

Reference points measured for Station calculation	
Points	The list of available points in the system.
Measured points	Contains a list of all points that have been measured.
Position	Positions the total station to the selected point. This button is only active after two points have been measured.
	Measures with the total station the selected point.

Results	
Average Error	Lists the average error in the computation.
Scale	Lists that scale factor from the computation.

Note: The **Average Error** and **Scale** indicate the initial precision for the total station control point.

Coordinate Calculation: Distance Intersection

Background information

The Distance Intersection calculation is used to determine the position of the Total Station coordinates by measuring distances to control points with known coordinates.

When to use

Use the Distance Intersection coordinate calculation

- to **determine** the initial total station control point with minimum **two known points** in a coordinate system
- after **moving** the total station **control point** to re-compute the total station coordinates

before starting the measurements.

Procedure

Follow these steps to configure the coordinate calculation - Distance Intersection.

Step	Action
1	Select the **Setup...** button in the **Sensor Location** dialog for a TPS sensor.
2	Select the Distance Intersection tab page.
3	Select a point from the list that will be measured for the Distance Intersection.
4	Aim the total station telescope to the selected point and press the **Measure** button.
5	The measurement will be executed on the total station and the point will be listed in the Measured Points list. **Notes**: ▪ The selected **measurement mode** (Point Editor) for this point will be used. For example, measurement mode "ATR": The horizontal angle, vertical angle and distance will be measured. However the horizontal and vertical angle will be considered with a very low weight. Measurement mode "Distance IR": The distance will be measured and used for the distance section computation.

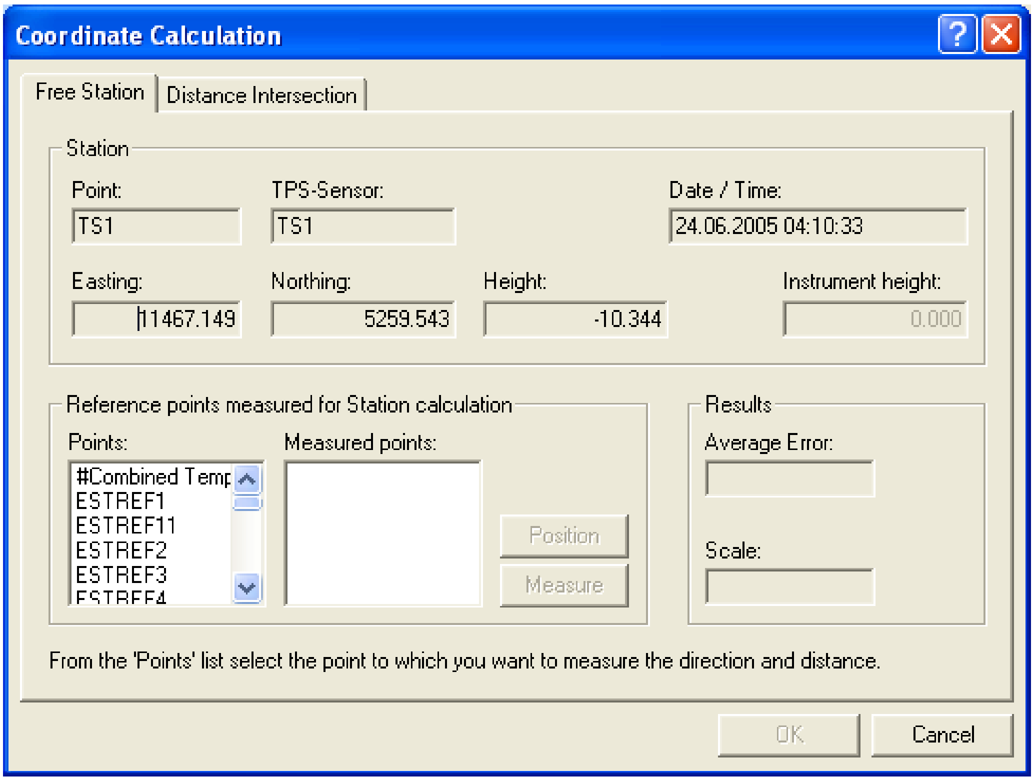
	▪ **Note for TM30/TS30 only**: The **Measure** button uses the **EDM Standard** mode. The used ATR mode depends on the Windows Registry. By default the software attempts measurements in both modes, normal ATR and low visibility ATR. For example, when the normal ATR mode succeeds, the measurement is calculated directly. If due to weather conditions the normal ATR mode fails then the low visibility ATR attempts a second measurement.
6	Repeat the Step 3 to 5 for the second point.
7	Select a third point from the list. Press the **Position** button to automatically position the total station telescope to the point and then press the **Measure** button. The measurement will be executed on the total station.
8	Confirm with the **OK** button and the calculated coordinates will be saved. **Note:** The coordinate types 'Reference', 'Current', 'Scan' and 'Setup' are updated after the Sensor Location is confirmed with **OK**.
9	The **Coordinate Calculation** dialog will be closed.

When the **second** point has been measured, the Total Station coordinates will be calculated. The calculated **Coordinates** will be displayed with the **standard deviation** and the **scale factor** of the solution.

A measured point can be deleted from the calculated solution via the right mouse menu "**Delete**".

Multiple points can be measured for an over determined solution of the coordinates using least squares techniques.

The Distance Intersection solution calculates and applies the orientation of the total station, which can be visualized in the Orientation Assistant. The calculated coordinates are not editable. The calculated coordinates are only used to manually determine the total station control point.



The table below describes the fields and buttons in the Coordinate Calculation dialog box.

Field/Button	**Description**
Station	
Point	The name of the Total Station control point.
TPS Sensor	The name of the sensor.
Date/time	The date/time when the point was last edited.
Easting	The easting of the Total Station control point.
Northing	The northing of the Total Station control point.
Height	The height of the Total Station control point.
Instrument height	The height of the sensor above the survey mark.

Reference points measured for Station calculation	
Points	The list of available points in the system.
Measured points	Contains a list of all points that have been measured.

Position	Positions the total station to the selected point. This button is only active after two points have been measured.
	Measures with the total station the selected point.

Results	
Average Error	Lists the average error in the computation.
Scale	Lists that scale factor from the computation.

Note: The **Average Error** and **Scale** indicate the initial precision for the total station control point.

Coordinate Calculation: GNSS

Follow these steps to configure the Coordinate calculation - GNSS.

Step	Action
1	Select the **Setup...** button in the **Sensor Location** dialog for a GNSS sensor.
2	Enter the coordinate offset of the GNSS Sensor in the **GNSS-Offset** fields as Easting Difference, Northing Difference and Height Difference, if required. The offset indicates the eccentricity of the GNSS antennae to the point.
3	Press the **Start** button to begin the GNSS measurements. The **GNSS** coordinates will be recorded and averaged and the **standard deviation** of the **coordinates** is calculated and displayed.
4	Press the **Stop** button to stop recording the GNSS Measurements.
5	Confirm with the **OK** button and the calculated coordinates will be saved. **Note:** The coordinate types 'Reference', 'Current', 'Scan' and 'Setup' are updated after the **Sensor Location** is confirmed with **OK**.
6	The **Coordinate Calculation** dialog will be closed.

Coordinate Calculation: Manual

The Total Station coordinates values of Easting Northing and Height can be entered manually in the **Point Editor** dialog. After confirming with the **OK** button, the coordinates will be saved and used for the next measurements in the measurement cycle. The instrument height can input in the **Orientation** dialog.

Total Station Standpoint Coordinates

Background information

The Total Station coordinates can be determined by various techniques:

- Manual entry of the coordinates
- Free Station using measured horizontal directions and distances
- Distance Intersection using measured distances
- GNSS Coordinates (requires a connected GNSS-Sensor)

The Free Station and Distance Intersection can only be measured with an initialized Total Station. The GNSS technique requires a connected GNSS Sensor. Manual entry of measured Total Station or GNSS data is not possible.

The Free Station, Distance Intersection and GNSS techniques can also be used for the automatic Total Station coordinate computations, when activated in the Options dialog. The movement of the control point can be monitored and automatically corrected. A time period can be defined for calculating the coordinates using the Median Technique for Total Station coordinates.

Total Station Coordinates

Follow these steps to configure the Total Station coordinates.

Step	Action
1	Select the menu **Configuration**, **Sensor Location...** or click the toolbar **Sensor Location button** .
2	The **Sensor Location** dialog will be displayed.
3	Select a location point for the Sensor and press the **Setup...** button.
4	The **Coordinate Calculation** dialog will be displayed.
5	Select the required technique (Free Station, Distance Intersection or GNSS) to determine the coordinates of the control point and follow the procedures to calculate the coordinates.

6	Confirm the new Total Station coordinates with the **OK** button.
7	The **Stand Point Settings** dialog will be closed and the new Total Station coordinates will be saved in the database. The **Sensor Location** dialog will be closed.
8	The **Point ID**, the **TPS Sensor** and the **Time** will be saved with the Total Station coordinates and are not editable. The technique used to determine the Total Station coordinates is also saved in the database.

Orientation

Background Information

The total station must be oriented before starting the measurements.

When to use

Use the Orientation wizard

- to **orientate** the total station instrument with **two known points** in a coordinate system (refer to Method A)
- after **replacing** the total station **instrument** to re-orientate the total station (refer to Method A)
- after **moving** the total station instrument **control point** to re-orientate the total station (refer to Method A)
- after **using** the total station instrument for **manual surveying** to re-orientate the total station (refer to Method A)
- to **set manually** the orientation for a **local coordinate system** (refer to Method B)
- to **enter** the **instrument height** for a total station (refer to set instrument height only)

before starting the measurements.

Procedure

In addition to the Free Station and Distance Intersection setup procedure two additional **manual** methods for orientation of the total station are available:

- **Orientation Method A "Known points"**: Determine the orientation with two known points (here: instrument control point and target point).
- **Orientation Method B "Set manually"**: Set manually the orientation for a local coordinate system.

Important: After accidentally changing the orientation of the **onboard Az value**, the total station must be re-orientated with Method A or B before starting the measurements.

Orientation Method A "known points"

Follow these steps to determine the orientation with two known points.

Step	Action
1	Select the menu **Configuration**, **Sensor Location...** or press the toolbar **Sensor Location button** . The Sensor Location dialog appears.
2	Select the Sensor that needs to be orientated from the list and click the **Orientation** button. The **Orientation** assistant is displayed.
3	The total station control point and sensor type selected in the **Sensor Location** dialog will be displayed. These fields are not editable. Click the **Next >** button, to display the next page.
4	Enter the instrument height if required. Do not modify the orientation value, because this value is only used for the orientation Method B "set manually". Click the **Next >** button, to display the next page.
5	Select the target point to measure for the orientation calculation. Click the **Next >** button to display the next page.
6	a. Aim manually the total station telescope to the selected target point selected in Step 5. b. Select **Use ATR** and press the **Measure** button to take the measurement to a known point (prism is necessary). GeoMoS Monitor reads the angles and the distance to the known target point. The orientation will be calculated and displayed in the dialog **Note for TM30/TS30 only:** The **Measure** button uses the EDM Standard mode. The used ATR mode depends on the Windows Registry. By default the software attempts measurements in both modes, normal ATR and low visibility ATR. For example, when the normal ATR mode succeeds, the measurement is calculated directly. If due to weather conditions the normal ATR mode fails then the low visibility ATR attempts a second measurement. c. OR **Deselect Use ATR** and press the **Measure** button to take the measurement to a known point. GeoMoS Monitor reads only the angles from the total station pointing to the known target point. The orientation will be calculated and displayed in the dialog
7	Confirm the calculated orientation with the **Finish** button. The **Orientation** assistant will be closed and the data (orientation and instrument

	height) will be saved and used for further measurements and calculations.

Orientation Method B "Set manually"

The information in this steps describes how to set the orientation value to null for a local coordinate system.

Step	Action
1	Select the menu **Configuration**, **Sensor Location...** or press the toolbar **Sensor Location button** .
2	Select the Total Station that needs to be orientated from the list and click the **Orientation** button. The **Orientation** assistant is displayed.
3	The total station control point and sensor type selected in the **Sensor Location** dialog will be displayed. These fields are not editable. Click the **Next >** button, to display the next page.
4	a. Aim manually the total station telescope to the defined null orientation to set manually the orientation value. b. Enter the instrument height if required and enter manually the GeoMoS orientation value = 0.000 c. Enter in the total station onboard program as Az value = 0.000. (Hz or Az depends on the used total station type)
5	Confirm the manually set orientation with the **Finish** button. The **Orientation** assistant will be closed and the data (orientation and instrument height) will be saved and used for further measurements and calculations.

Set instrument height only

The information in this steps describes how to set the instrument height of a total station.

Step	Action
1	Select the menu **Configuration**, **Sensor Location...** or press the toolbar **Sensor Location button** .
2	Select the Total Station that requires an instrument height from the list and click the **Orientation** button. The **Orientation** assistant is displayed.
3	The total station control point and sensor type selected in the **Sensor Location** dialog will be displayed. These fields are not editable. Click the **Next >** button, to display the next page.
4	Enter the **instrument height**. Do not modify the orientation value.
5	Confirm the instrument height with the **Finish** button. The **Orientation** assistant will be closed and the instrument height will be saved and used for further measurements and calculations. The orientation value remains constant.

TPS Properties

Total stations have many configuration options related to the measurement procedure, calculations, corrections and the update of the control point using GNSS results.

TPS Properties: Measurements

The table below describes the fields in the TPS Properties: Measurement tab dialog box.

Field	Description
Multiple Measurements	
Number of measurements	This value defines how many times the measurement is repeated for a single measurement. The Hz angle, Vz angle and slope distance are averaged and the standard deviation is calculated.
Retries if out of tolerance	This value defines how many times GeoMoS will re-measure the point until it achieves the specified precision.

Point Not Found	
Retries if point not found	This value defines how many times GeoMoS will re-try to measure the point if it is not found. The purpose of this option is to avoid the case that a point was not measured because of some temporary obstruction.
Delay in between	This value defines the delay between each subsequent attempt to measure the point after a point was not found.

Tolerances	
Hz	This value defines the expected precision of the horizontal angle when making multiple measurements. If the calculated standard deviation is less than this value then GeoMoS will re-measure the point.
V	This value defines the expected precision of the vertical angle when making multiple measurements. If the calculated standard deviation is less than this value then GeoMoS will re-measure the point.
Slope	This value defines the expected precision of the slope distance when

Distance	making multiple measurements. If the calculated standard deviation is less than this value then GeoMoS will re-measure the point.

Special	
Blunder tolerance:	This value defines the maximum deviation from the expected position that will be allowed. If the resulting coordinate is further from the last position (3D) than this amount, then it will be regarded as a blunder and only the raw measurements will be stored in this database. No result will be computed. The purpose of this check is to avoid the accidental measuring of a wrong prism, which may happen if the prisms are closely spaced from the perspective of the total station. To prevent a blunder from occurring a Measurement Mode of ATR (Small Field of View) can be used with some total stations. If a blunder check occurs a "Point blunder check failed" message will be generated.
Reset theo before normal group	Requires a switchbox (Art. No. 744793) to be attached to the sensor. If this option is set GeoMoS will send a command to the switchbox to cycle the power on the total station. This option is used to avoid problems with instable firmware on the total station to enable continuos, uninterrupted operation of the monitoring system.

Sensor Name	The name of the sensor.
Set as default	Check this option for the setting entered for this sensor to be the default for all new sensors of this type that are connected to GeoMoS.

TPS Properties: Calculations

The Calculation page contains the options for the Meteo Model, Coordinate Calculations, Compensator and Distance Reduction.

The table below describes the fields in the TPS Properties: Calculations tab dialog box.

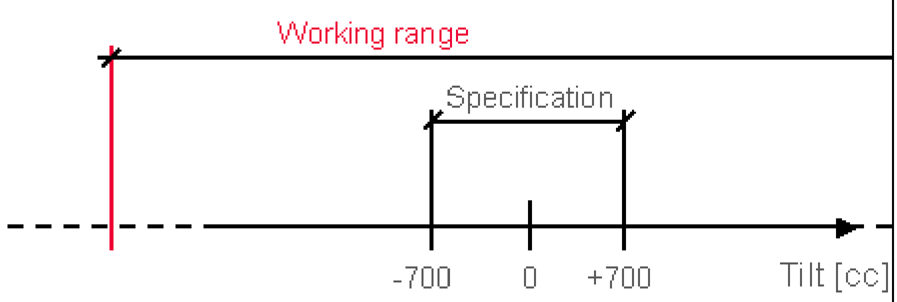
Field	Description
Coordinate Calculations	
Full measurement (recommended)	All angle and distance measurements are used to calculate the target point co-ordinates. This technique uses standard reduction techiques for the coordinate calculation and it recommended in most cases where ATR or other good pointing techniques are executed. **Warning:** ▪ The **Full Measurement** option should not be used with Distance (IR), Distance (LO) and ATR w/o Distance Measurement Modes. ▪ **Poor quality results** may be obtained if measuring with Signal Scan (IR) or Signal Scan (LO) Measurement Modes. Refer to the technical description of Signal Scan for more information.
Only measured distance	This is a special computation technique that uses only the measured distance to calculate the target point coordinates. The technique is dependent on the geometry of the measurement network for the coordinate calculation of target points. It can be useful in situations where the measured directions are of poor accuracy, but the distance is reliable. Such cases can be when measuring over very large distance between the Total Station and prisms. See the technical description of the Distance Only Calculation for further information. **Warning:** ▪ The **Only Measured Distance** option should be used only if it is not possible to measure with ATR or Signal Scan. ▪ If using the **Only Measured Distance** option, all prisms should be measured with the measurement mode Distance (IR) or

	Distance (LO). ATR and other measurement modes should not be used with Only Measured Distance. ▪ If using **Only Measured Distance** you should set the Distance Reduction to Use End Heights.

Meteo Model	The Meteo Model used for the atmospheric correction of the measured distances can be selected.
No Correction	No atmospheric correction will be applied to the measured distances.
Reference Distance	A scale factor, PPM value, is calculated from measured reference distances. After a point group of type PPM, or FreeStation plus the Scale Factor option, is measured, the scale factor, PPM, value is calculated and saved. The PPM value is calculated from the ratio of the calculated reference distance and measured distance. **Important:** A Reference Distance correction can only occur when a point group with the type PPM, or a FreeStation group plus the Scale Factor option, exists and is measured in the Measurement Cycle. If there is no point group with the type PPM or FreeStation + Scale Factor existing in the Measurement Cycle then the last available PPM value will be used to correct the measurements.
Temperature / Pressure	The temperature and pressure measurements from a single meteorological sensor will be used to correct the measured distances. A combined temperature and pressure sensor at the Monitoring System will be used. If more than one meteorological sensor is present, ... ▪ the multiple meteorological data will not be used to calculate the atmospheric correction for the Temperature / Pressure option. Refer to "Multiple Temperature / Pressure". ▪ the 3D distance between the "setup" coordinate of the temperature and pressure sensor and the total station "setup" coordinate determines which meteorological data will be used for the correction. If no temperature / pressure sensor is available the system will then use the Meteo Model "No Correction".

Multiple Temperature / Pressure	The temperature and pressure measurements from multiple meteorological sensor will be used to correct the measured distances according to the spatial position of the measurement line within the network of meteorological sensors. Two meteorological sensors are used to interpolate the target temperature and pressure. One meteorological sensor must be located above the target point and one must be located below the target point and the target temperature and pressure will be linearly interpolated between the two sensors. The temperature and pressure at the target point and the temperature and pressure at the total station control point is averaged and used for the atmospheric correction. The "setup" coordinate determines which meteorological sensor is used. In some cases it may occur that not enough meteorological sensors are available to interpolate the temperature and pressure at the target point. When the target temperature and pressure cannot be interpolated the system defaults to the "Temperature / Pressure" option and will attempt to correct the measured distance using the temperature and pressure at the total station control point. If no temperature / pressure data is available the system will then use the Meteo Model "No Correction". **Note:** Refer to the Meteo Corrections settings for a comparison of the advantages and disadvantages of reference distances and meteo sensor.

Distance Reduction	
Use Vertical Angles	The reduction of the distance to horizontal can be selected to use the measured vertical angle (recommended) of the control point and target points.
Use End Heights	The reduction of the distance to horizontal can be selected to use the heights (i.e. elevations) of the control point and target points. During the point learn process the reduction of the distance will always use the measured vertical angle. **Warning:** Distance reduction using End Heights should only be used together with the Coordinate Calculation Only Measured Distance.

<table>
<tr>
<td>Compensator</td>
<td>
The total station compensator readings can be read from the instrument before the start of each 'Normal' point group. The total station will be turned to the Hz=0 circle position in both faces and read the longitudinal and transverse compensator values from the total station sensor. The compensator readings will be stored in the database.
The value specified in the Tolerance input field value will be checked after the readings have been taken. The status message "Compensator out of range" will be produced once before the 'Normal' point group if the measured value exceeds the specified tolerance.
Important:
If the compensator is set to ON in the Sensor Manager it is assumed that the current value of the compensator measurement value is valid. It is then the customers own responsibility that the in cases of unstable total stations the Tolerance of the compensator is checked.


A mislevelling of the compensator outside the total station compensator specification may causes lower accurate compensation of the angle measurement and outside the working range causes the message "Point not found". If the compensator is outside the working range the electronic bubble displays no graphical and numerical bubble anymore. If the compensator is outside the specification of the total station the onboard software will not measure anymore, but GeoMoS still does.
Warning:
The status message "Compensator out of range" is also very likely in case of a weak communication line.
</td>
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</table>

Sensor name	The name of the sensor.
Set as default	Check this option for the setting entered for this sensor to be the default for all new sensors of this type that are connected to GeoMoS.

TPS Properties: Corrections

Important Information:

- If there is no Vz Correction or PPM Correction activated in the Point Group Editor than you have to check that the displayed values in the tab Corrections are zero otherwise you should reset them by pressing the appropriate buttons: Vz Corr = 0 or PPM Corr = 0.

- It is very important when you reset the corrections that you confirm the changes by closing the TPS Properties and the Sensor Location with OK. If this is not done the reset corrections will not be activated.

Corrections Settings:

The table below describes the fields in the TPS Properties: Corrections tab dialog box.

Field	Description
Vz Correction	This field shows you the value of the Vz Correction which was used to correct the last V angle measurement in the measurement sequence.
PPM Correction	This field shows you the value of the PPM Correction which was used to correct the last distance measurement in the measurement sequence.
Sensor Name	The name of the sensor.

TPS Properties: GNSS Update

These options can be used if a GNSS sensor is co-located with the total station and is to be used to update the coordinates of the Total Station control point.

Note:

GNSS Update should not be combined with Free Station or Distance Intersection Point Groups. Only one method for updating the station coordinates should be used for a given total station.

The table below describes the fields in the TPS Properties: GNSS Update tab dialog box.

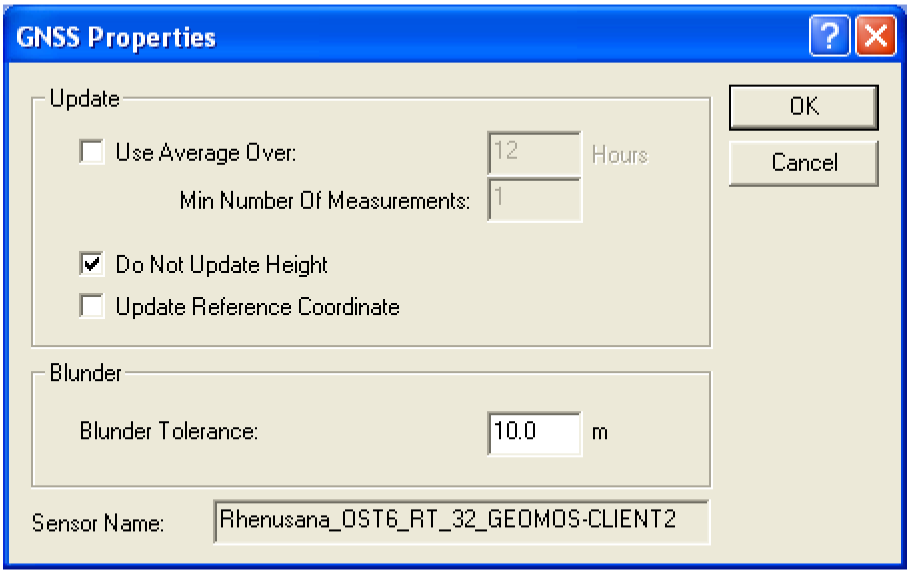
Field	Description
Update The TPS Station Coordinate With GNSS Coordinate Before Every 'Normal Group'.	This option defines if the GNSS will be used to update the Total Station coordinates. The update is done immediately before a Point Group of type Normal is measured.

Parameters	
GNSS Sensor	Select the GNSS sensor that will be used. Be sure that the offsets for this GNSS are set correctly in the GNSS Sensor Setup in the Sensor Location Editor.
Do not update height	If this option is checked only the horizontal position of the control point will be updated by the GNSS coordinate and not the height. The purpose of this option is to avoid updating the height with a low accuracy estimate from the GNSS. The height component is less accurate than the horizontal coordinates when using GNSS due to the satellite geometry.

Sensor name	The name of the sensor.

GNSS Properties

GNSS sensors have many configuration options related to the measurement procedure and calculations.



The table below describes the fields in the GNSS Properties dialog box.

Field	Description
Update	
Use average over	If this option is checked (recommended) then an average position (median) from the GNSS will be used. The longer the positions of the GNSS are averaged over the more precise the coordinate will be. It is for example important to have the coordinate as precise as possible to avoid updating the control point coordinate will incorrect coordinates. **Note:** The average GNSS position is computed as median.
Min number of measurements	Below this amount of GNSS measurements there will be no average computed. This field is only active if you select the **Use average over** check box.

Do not update height	If this option is checked only the horizontal position of the control point will be updated by the GNSS and not the height. The purpose of this option is either to avoid updating the height or trigger misleadingly limit checks messages with a low accuracy estimate from the GNSS. The height component is less accurate than the horizontal coordinates when using GNSS due to the satellite geometry. **Notes:** ▪ The current measured GNSS height is always displayed in the graphs and stored to the GeoMoS Results table in the database. The accuracy of the GNSS height can be analyzed. ▪ If the option **Do not update height** is active the current measured GNSS height is not used to update the height and therefore not written to the GeoMoS Coordinates table in the database.
Update Reference Coordinate	Whenever a GNSS result is calculated the reference coordinate for the point will be updated. This is important if another sensor is measuring to the same point to calculate its own position. If this option is unchecked whenever a GNSS result is calculated the current coordinate for the point will be updated.

Blunder	
Blunder Tolerance	This value defines the maximum deviation from the expected position that will be expected. If the resulting coordinate is further from the last position than this amount (3D), then it will be regarded as a blunder and will not be stored in this database. If a blunder check occurs a "Point blunder check failed" message will be generated.

Sensor name	The name of the sensor.

Virtual Sensor

Virtual Sensor

Background information

The virtual sensor computation functionality is license protected. This functionality can be purchased with GeoMoS Monitor Option 1 (article number 774 135). Please contact your Leica representative.

Definition

The table below gives a definition of a sensor and a virtual sensor.

Naming	Definition
Sensor	A sensor is a physical sensor that is transmitting data.
Virtual Sensor	A so-called "virtual sensor" uses the output of one or more sensors that can be modeled using constants, mathematical functions and/or logic operators in a formula. A virtual sensor is in some sense a model that is build from transmitting data and formulas. Virtual sensors can be scheduled in the measurement cycle and are displayed in the tree view in the Analyzer application.

To open the Virtual Sensor Editor

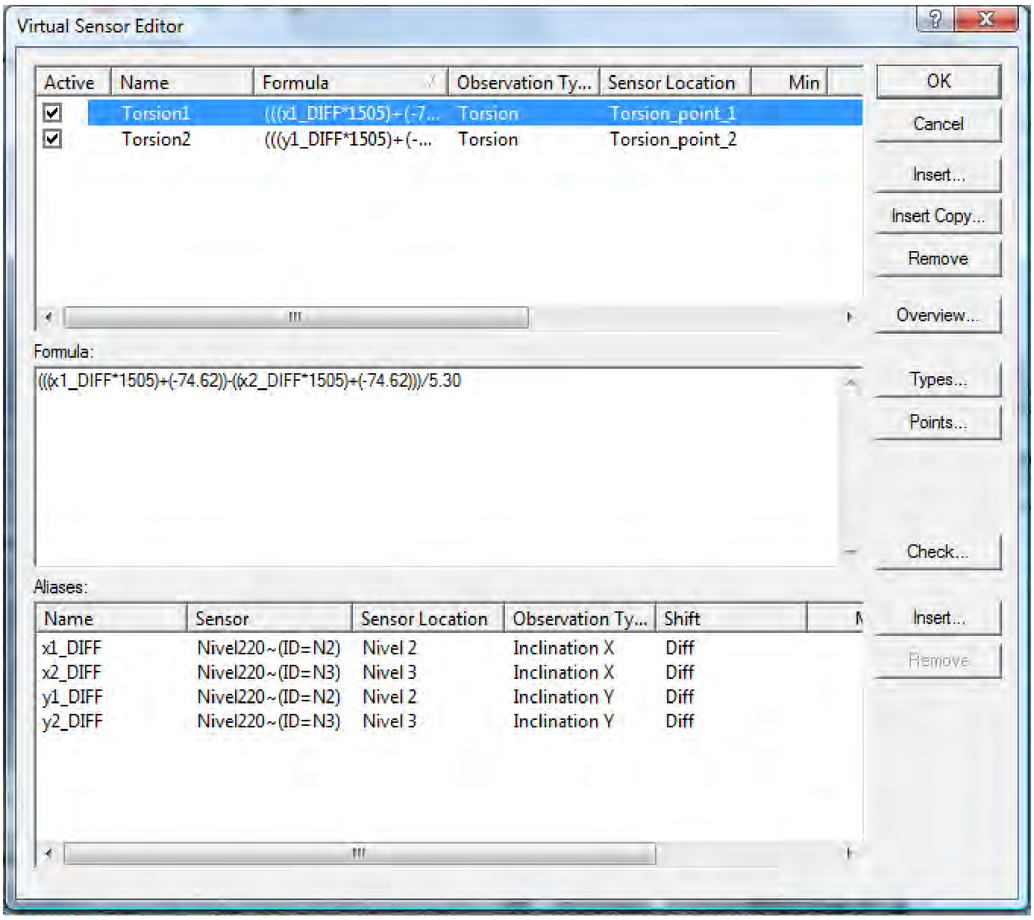
To open the Virtual Sensor Editor follow these steps.

Step	Action
1	Select the menu **Configuration**, **Virtual Sensor Editor...** .
2	The **Virtual Sensor Editor** dialog will be displayed.
3	Press the upper right **Insert** button to add a new line to the Virtual Sensor Editor dialog. Enter a virtual sensor **Name**, the **Observation Type**, **Sensor Location** and if required **Min/Max** values and the **Description**.
4	The formula of a virtual sensor must be entered in the **Formula field**.

5	The output of physical sensor data can only be used in a formula with an **Alias** name. The different alias names are defined in the **Aliases field**.
6	Confirm the entered configuration and changes with the **OK** button.
7	The dialog will be closed and the defined virtual sensors and aliases will be saved in the database.
8	Select the menu **Configuration**, **Measurement Cycle Editor...** and add the Virtual Sensor as "Sensor" in the measurement cycle.

Note: The above description guided you through the creation process by describing the minimum settings only.

Virtual Sensor Editor Properties



The table below describes the fields and buttons in the Virtual Sensor Editor dialog box.

Field/Button	Description
Virtual Sensor	You can define virtual sensors using the **Insert...** button.
Active	This check box is used to activate/deactivate virtual sensors. Only active virtual sensors will be available for measurement.
Name	Displays the name for the virtual sensor. For example "Pythagoras".
Formula	Displays the current valid computation of the virtual sensor. The formula is entered in the **Formula field** below.
Observation Type	Displays the Observation Type of the virtual sensor.
Sensor Location	Displays the selected sensor control point of the virtual sensor.
Min or Max	Use this value to limit the virtual sensor results to a minimal and/or maximum value. No virtual sensor results outside the set limits will be stored to the database. Virtual sensor results outside the set limits causes the message "Measurement out of range" on the Messages tab.
System Unit	Displays the current system unit. This is the physical quantity of the Observation Type.
Description	A user defined remark or comment about the defined virtual sensor and the formula.

Formula	The formula of the selected virtual sensor is displayed. It is possible to combine data from physical sensors using Aliases with constants, mathematical functions and/or logic operators.

<table>
<tr><td>Aliases</td><td></td></tr>
<tr><td>Name</td><td>Enter an unique name for the alias.</td></tr>
<tr><td>Sensor / Point ID</td><td>To identify a physical sensor data in a formula with an alias the combination of the Sensor name and Point ID is required.</td></tr>
<tr><td>Sensor Location</td><td>Displays the selected sensor control point of the observation type.</td></tr>
<tr><td>Observation Type</td><td>Displays the as alias available Observation Type of the selected physical sensor.

Note: The observation types Hz, V, Slope Distance, Easting Difference, Northing Difference, Height Difference are not available for the definition of an alias.</td></tr>
<tr><td>Shift</td><td>Select between Abs, Null or Diff.

<table>
<tr><th>Shift</th><th>Description</th></tr>
<tr><td>Absolute</td><td>Use this shift to select the absolute value.</td></tr>
<tr><td>Null</td><td>Use this shift to select the null value. Depending on the sensor the null value is set either in the Null Measurement Editor or the Point Editor.</td></tr>
<tr><td>Difference</td><td>Use this shift to select the difference between the current value and the null value. The difference is computed with the "current" value minus the "null" value.</td></tr>
</table>
</td></tr>
<tr><td>Max Age [h]</td><td>The maximum age defines the expiry date of the physical sensor data used in that specific alias. Invalid aliases outside the maximum age causes the message "No measurements available" on the Messages tab and the virtual sensor formula is not computed.</td></tr>
<tr><td>System Unit</td><td>Displays the current system unit. This is the physical quantity of the Observation Type.</td></tr>
</table>

	Adds a new line to the **Virtual Sensor Editor** (Upper Insert button) dialog or **Aliases field** (Lower Insert button).

Insert Copy...	Copies a existing line to the Virtual Sensor Editor.
Remove	Press this button to delete a selected virtual sensor (Upper Remove button) or alias (Lower Remove button) .
Overview...	List all defined Virtual sensors.
Types...	Use this button to create additional Observation Types that can be used for virtual sensor or all sensors that are connected to the Campbell Datalogger.
Points...	If the control point is not yet defined use the **Points...** button to switch to the Point Editor to create the sensor control point.
Check...	Checks if the formula structure is correct.
Remove	Removes selected lines only.

Observation Types

Background information

Leica GeoMoS distinguishes between **standard system** observation types and **user defined** observation types. A standard system observation type is pre-defined by the GeoMoS software and can be used with the available system units that are configurable in the **Customize** dialog. Whereas a user defined observation type can be added from the customers and has either one of the available system units or no unit.

Observation types are used throughout the system for virtual sensors, datalogger configuration, limit checks and visualization in the different views or the GeoMoS Analyzer.

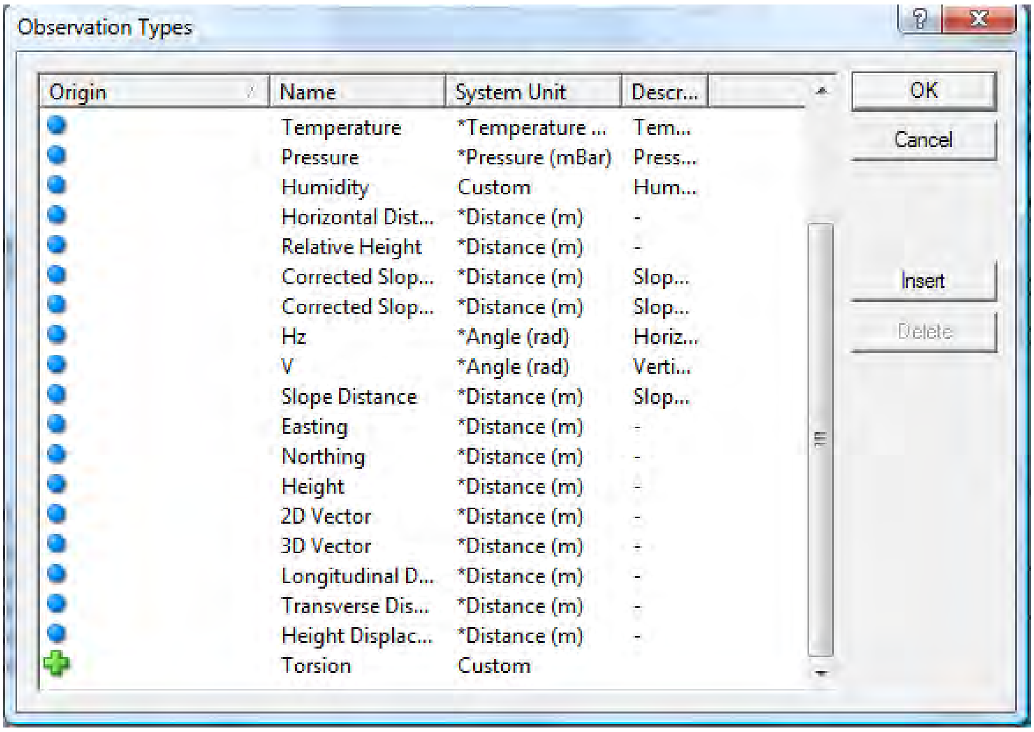
To open the Define Observation Types dialog

Follow these steps to open the Define Observation Types dialog.

Step	Action
1	Select the menu **Configuration**, **Virtual Sensors...** and press the **Types...** button or select the menu **Configuration**, **Sensor Manager...** and press the **Types...** button during the configuration of the Campbell datalogger parameters.
2	The **Observation Types** dialog will be displayed. Each row shows one observation type.
3	Select the **Insert** button to create a new observation type and enter the observation type **Name**, select a suitable **System Unit** and if required a **Description**.
4	Press the **OK** button to save the changes and to close the dialog.

Note: The above description guided you through the creation process by describing the minimum settings only.

Read below to learn about all properties in detail



The table below describes the fields and buttons in the Observation Types dialog box.

Field/Button	Description
Origin	This column displays a symbol for the observation type. The origin of the observation type can be distinguished.  Standard system observation type  User defined observation type
Name	The name is used to identify the observation types throughout the system. For example, in Limit Checks and Campbell Datalogger Parameters. Standard system observation types can be either a one-to-one transmission of a measured value (e.g. Hz, Inclination X, Pressure) or a combination of data and formulas that are basically included in the system for total stations.
System Unit	The system unit is the physical quantity of the observation type (e.g. distance, temperature, ...). System units are available and can be configured within the Customize dialog and marked with an asterisk *. The observation types are stored with their default internal system unit to the

<table>
<tr><td></td><td>database. The default internal system units are listed in the table below and may be important for the computation of virtual sensors.
<table>
<tr><th>Available system units</th><th>Internal unit</th></tr>
<tr><td>Angle</td><td>rad</td></tr>
<tr><td>Distance</td><td>m</td></tr>
<tr><td>Inclination</td><td>rad</td></tr>
<tr><td>Pressure</td><td>mBar</td></tr>
<tr><td>Temperature</td><td>°C</td></tr>
</table>
If there is for an user defined observation type no suitable system unit available the default system unit Custom should be selected.
<table>
<tr><th>Default system units</th><th>Internal unit</th></tr>
<tr><td>Custom</td><td>not available</td></tr>
</table>
</td></tr>
<tr><td>Description</td><td>A user defined remark or comment about the observation type. For example a text description of the use or unit of the observation type.</td></tr>
</table>

Insert...	If the required observation type is not yet defined in the standard system observation types use the **Insert...** button to create a new user defined observation type. A new line is created in the table for the new observation type.
Delete	The selected observation type in the table will be deleted.

Standard system observation types

This table lists alphabetical ordered all pre-defined standard system observation types in the GeoMoS software. In some cases the observation type and the system unit is identical.

Standard system observation types	Description	System Unit	Monitor Virtual Sensor	Analyzer Multi Graph
Atmospheric PPM		PPM	yes	yes
Corrected Hz Angle		Angle	yes	yes
Corrected Slope Distance (Atmos PPM)	Calculated corrections from measured meteorological values (temperature and pressure) applied to the slope distance. TPS only.	Distance	yes	yes
Corrected Slope Distance (Ref PPM)	Calculated corrections from distance measurements to control points ([PPM Point Groups]()) applied to the slope distance. TPS only.	Distance	yes	yes
Corrected V Angle		Angle	yes	yes
Distance		Distance	yes	yes
Easting	Computed coordinate component (distance reductions and coordinate system applied) .	Distance	yes	yes
Height	Computed coordinate component (distance reductions and coordinate	Distance	yes	yes

	system applied) .			
Height Displacement	Computed coordinate component displacement related to the 'Null' coordinate.	Distanc e	yes	yes
Horizontal Distance	-	Distanc e	yes	- - -
Humidity	-	Custom	yes	- - -
Hz angle	-	Angle	yes	yes
Inclination X	-	Angle	yes	yes
Inclination Y	-	Angle	yes	yes
Longitudinal Displacement	Computed coordinate component displacement related to the 'Null' coordinate.	Distanc e	yes	yes
Longitudinal Tilt	Compensator value L measured in two faces with the sign of the face **I** measurement.	Angle	- - -	yes
Nivel_Temperature	-	Temper ature	yes	- - -
Northing	Computed coordinate component (distance reductions and coordinate system applied).	Distanc e	yes	yes
Orientation		Angle	yes	yes
Pressure	-	Pressur e	yes	yes
Rain Measurement	-	Custom	yes	- - -

Reference PPM		PPM	yes	yes
Relative Height	-	Distance	yes	
Slope Distance	-	Distance	yes	yes
Temperature	-	Temperature	yes	yes
Transverse Displacement	Computed coordinate component displacement related to the 'Null' coordinate.	Distance	yes	yes
Transverse Tilt	Compensator value T measured in two faces with the sign of the face **I** measurement.	Angle	- - -	yes
V angle	Raw vertical angle (if required)	Angle	yes	yes
Vz Correction		Angle	- - -	yes
2D Vector	-	Distance	yes	- - -
3D Vector	-	Distance	yes	- - -

User defined observation types

These observation types can be defined in the **Define Observation Types** dialog and used throughout the system.

Available Functions

Build-in Constants

The following table gives an overview of the constants supported by the default implementation.

Name	Value	Description
_Pi	3.14159 26535...	Mathematical constant
_e	2.71828 18284...	Mathematical constant
_Epoch	e.g. 39458.36736	Current time stamp as Julian Date

Build-in Functions

The following table gives an overview of the functions supported by the default implementation. It lists the function names, the number of arguments and a brief description.

Name	Arguments	Description / Example
sin	1	sine function
cos	1	cosine function
tan	1	tangens function
asin	1	arcus sine function
acos	1	arcus cosine function
atan	1	arcus tangens function
sinh	1	hyperbolic sine function
cosh	1	hyperbolic cosine function
tanh	1	hyperbolic tangens function

asinh	1	hyperbolic arcus sine function
acosh	1	hyperbolic arcus cosine function
atanh	1	hyperbolic arcus tangens function
log2	1	logarithm to the base 2
log10	1	logarithm to the base 10
log	1	logarithm to the base 2
ln	1	logarithm to the base e (2.71828...)
exp	1	e raised to the power of x
sqrt	1	square root of the value
sign	1	sign function -1 if x<0; 1 if x>0
rint	1	rounds to nearest integer
abs	1	absolute value
if	3	if ... then ... else ... if(sinx>0,+1,-1)
min	var	min of all arguments
max	var	max of all arguments
sum	var	sum of all arguments
avg	var	mean value of all arguments

Build-in Binary Operators

The following table lists the default binary operators supported by the parser.

Operator	Meaning	Priority
and	logical and	1
or	logical or	1

xor	logical xor	1
<=	less or equal	2
>=	greater or equal	2
!=	not equal	2
==	equal	2
>	greater than	2
<	less than	2
+	addition	3
-	subtraction	3
*	multiplication	4
/	division	4
^	raise x to the power of y	5

GeoMoS Defined Functions

The following table gives an overview of the GeoMoS defined functions supported by the default implementation.

Name	Meaning	Syntax	Example
rnd	random number	rnd(min,max)	rnd(-5.0, +5.0) results in a random number between -5.0 and +5.0, e.g. 4.79
frac	fractional part	frac(value)	frac(3.14159) results in 0.14159
mod	modulo	mod(value,quotient)	mod(17,4) results in 1

Point Editor

Point Editor: Overview

Background information

Points can be created or edited in the system by various methods including Inserting, Learning, Importing or Manual Input.

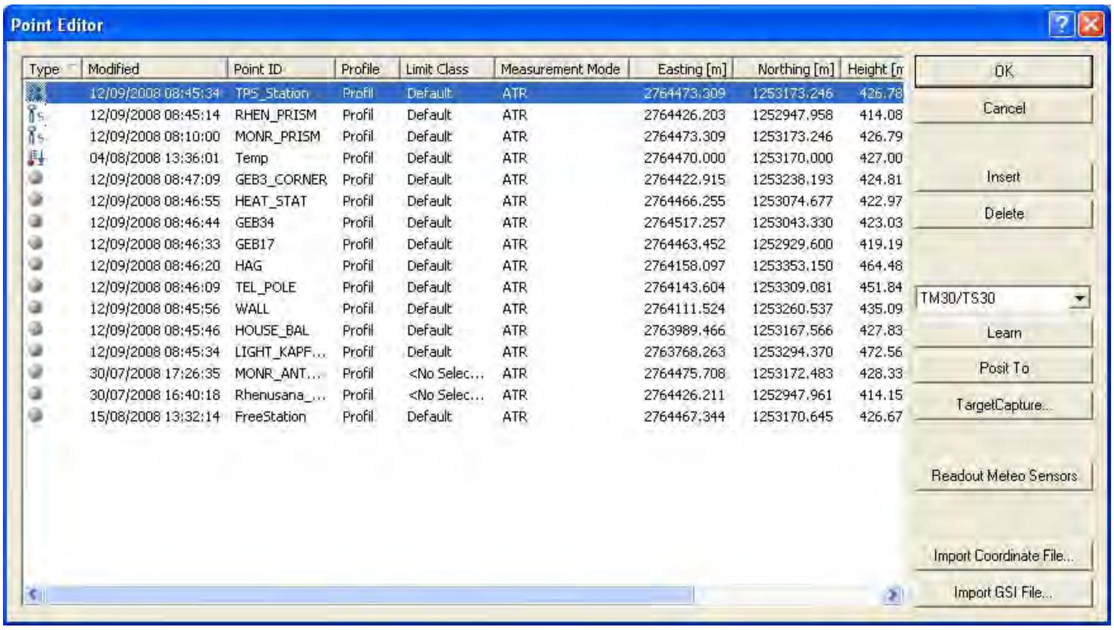
Open the Point Editor

Follow these steps to open the Point Editor.

Step	Action
1	Select the menu **Configuration**, **Point Editor...** or click the toolbar **Point Editor button** .
2	The **Point Editor** dialog will be displayed.
3	Edit the existing points or create new points with the **Insert Point** button.
4	Right-click on each field to be edited and choose the option **Modify**. Enter the value and confirm with Enter. To copy the value to other points, right-click on the cell with the correct value and choose **Paste Mode** then click and drag to select the destination cells. After using paste mode, right-click and choose Paste Mode again to return to normal mode.
5	Confirm the changes with **OK**.
6	The dialog will be closed and the changes and new points will be saved in the database.

Note: The above description guided you through the creation process by describing the minimum settings only.

Point Editor Properties



The table below describes the fields and buttons in the Point Editor dialog box.

Field/Button	**Description**
Type	This column displays an icon symbol for the type of point.  Observation point (prism)  Total Station control point  GNSS NMEA sensor control point connected by serial  GNSS NMEA sensor control point connected by TCP/IP  GNSS Spider Product (RT Positioning Product or PP Positioning Product) sensor control point  Leica Disto control point

	 Water level  Leica Nivel 20/200 and other sensor control point  Humidity sensor control point  Temperature sensor control point  Combined temperature/pressure sensor control point  Pressure sensor control point  Rain gauge  Combined temperature/pressure/humidity sensor control point  Leica DNA and Sprinter Level control point  Campbell Scientific datalogger  Virtual sensor  Multiple sensors located on a single point ID
Modified	The date and time the point was measured and the coordinate type 'current' updated.
Point ID	The Point ID is used to identify the point throughout the system. For example, in point groups and profiles.
Profile	If the profile is changed, then the calculation of the displacement will be immediately effective using the new profile. This can cause large variations in the calculated displacement from the previous measurements and can cause tolerance exceeded messages to be generated. When the profile of a point is changed, it can also affect

	the measurement cycle order if profiles have been used to define point groups.
Limit Class	The limit class is used to test the conditions if a tolerance has been exceeded.
Measurement Mode	The Measurement Mode. **Important:** Applies only to total stations.
Easting (m), Northing (m), Height (m)	The coordinate type 'current' is displayed. The column **Epoch** displays the date and time the point was measured and coordinates were computed. Defines the spatial position of the point. If the coordinates are changed it can cause large variations in the calculated displacement from the previous measurements and can cause tolerance exceeded messages to be generated.
Reflector Height (M)	When the height of reflector is changed or the reflector is replaced the height of the reflector can be edited. The reflector height is used for the distance and height reduction of the measurements. Errors in the reflector height input can lead to errors in the reduction of the measurements.
Add Const. (m)	The Additive Constant is the current additive constant for the prism and is applied for all following measurements. The additive constant used for previous measurements can be post processed in the Analyzer application.
Remark	A user defined remark or comment about the point. For example a text description of the location or status of the point.

	A new line is created in the table for the new point. The point data can be entered in the available columns. 1. Select the menu **Configuration**, **Point Editor...**, **or click** the toolbar **Points button** . 2. The **Point Editor** dialog will be displayed. 3. Press the **Insert Point** button.

	4. A new line will appear in the table. 5. The time and date column will be set to the current time. 6. Enter the **Point ID**, **Profile**, **Limit Class** and the **Coordinates** for the point.
Delete	The selected points in the table will be deleted. A point cannot be deleted when it is still used in a point group.
TM30/TS30	If you have multiple total stations, **make sure** you select the correct sensor before pressing the **Learn, Posit To or TargetCapture** buttons.
Learn	See Learn for more information. The total station selected in the list box above is used to learn the point.
Posit To	Use this button to make the currently selected total station position to (aim at) the currently selected point.
TargetCapture...	TM30/TS30 only: Use this button to retrieve an telescopic camera image from the aimed direction of the selected total station.
Readout Meteo Sensors	Use this option to read out the current temperature and pressure from the attached meteo sensors. This will ensure that the correct meteo information is used in the coordinate calculation when learning points.
Import Coordinate File...	Import points from an ASCII file. See Import file for more information.
Import GSI File...	Import points from a GSI file. See Import file for more information.

Note:

Changes to the data are valid from the time of the changes. It may not be possible to reprocess previous measurements if changes have been made, except for Additive Constant.

TargetCapture

TargetCapture makes the telescopic camera image available for visual documentation of the point measured. Obstructions in the line of sight can be inspected remotely, avoiding safety concerns in high-risk environments.

- The TargetCapture feature is only supported by Total Stations from type TM30 or TS30.
- The TargetCapture feature is only available in the manual mode. It is not possible to use the TargetCapture feature in the automatic measurement cycle and to capture images once a day for example.
- The TargetCapture feature has no zoom function. The zoom factor is set to endless.

Make an TargetCapture of a point:

Follow these steps to make an TargetCapture of a point.

Before you begin: The total station should be orientated and the selected point should already be learnt.

Step	Action
1	Select the appropriate total station in the list box TM30/TS30 .
2	Select a point to be aimed at by the total station.
3	Press the button Posit To . The total station posits to the currently selected target.
4	Press the button TargetCapture... .
5	Select the size of the picture. There are three different sizes available. • Small (175x120 pixels) • Medium (350x240 pixels) • Large (700 x 480 pixels)
6	GeoMoS retrieves the telescopic camera image from the total station. The time that this process takes is dependent on the size of the image and the communication connection between the total station and GeoMoS. The TargetCapture will be automatically stored on you local hard disk (C:\Documents

	and Settings\All Users\Documents\Leica Geosystems\GeoMoS\TargetCapture\).
7	When finished the TargetCapture is displayed as a non-modular window on the screen. e.g. 
8	Optional: To save the image on a different location, right click on the header of the window and select **Save Picture...**.
9	Press ☒ to close the window.

Learn

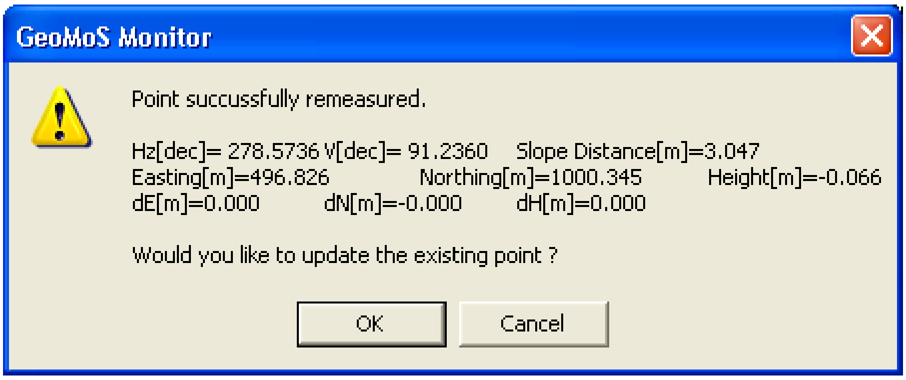
Points can measured from the Total Station for convenience or if the coordinates of the points are not known.

Note:

- The Total Station must be correctly positioned and orientated before learning points.
- Only a single measurement will be used to learn the point.

Follow these steps to learn new points.

Step	Action
1	Select the menu **Configuration**, **Point Editor...**, **or click** on the toolbar **Points button** .
2	The **Point Editor** dialog will be displayed.
3	Press the **Insert Point** button.
4	A new line appears in the table. Edit the Point Id , Profile and Limit Class.
5	Please notice the column Measurement mode. The measurement mode you choose depends on the connected Total Station. For example, "Reflectorless" Mode can only be chosen if the Total Station supports this feature.
6	The **Point Learn** dialog is displayed.
7	Select the Total Station from which the target point should be measured. The target point coordinates will be calculated using the Total Station coordinates and the measurement.
8	Point to the target point.
9	Press the **Measure** button to start the measurement. The selected **measurement mode** for this point will be used. For example, measurement mode "ATR": The horizontal angle, vertical angle and

	distance will be measured and the coordinate of the point calculated. The **Measure** button can be pressed again to repeat the measurement as often as required. **Note for TM30/TS30 only**: The **Learn** button uses the **EDM Standard** mode. The used ATR mode depends on the Windows Registry. By default the software attempts measurements in both modes, normal ATR and low visibility ATR. For example, when the normal ATR mode succeeds, the measurement is calculated directly. If due to weather conditions the normal ATR mode fails then the low visibility ATR attempts a second measurement.
10	When existing points are learnt again, the dialog displays the **Difference from the last measured coordinate**. The dialog can be closed with the **Cancel** button and the existing data will not be changed. 
11	Click the **OK** button to accept the measured coordinates and the coordinates will be updated in the table.
12	The **Point Learn** dialog will be closed and the new values will be displayed in the table. The time and date column will be updated to the current time. The Profile column will initially show No Profile and the Limit Class column will initially show the Standard Limit Class that was defined during the installation. The Additive Constant and Reflector Height will be set to zero as default.

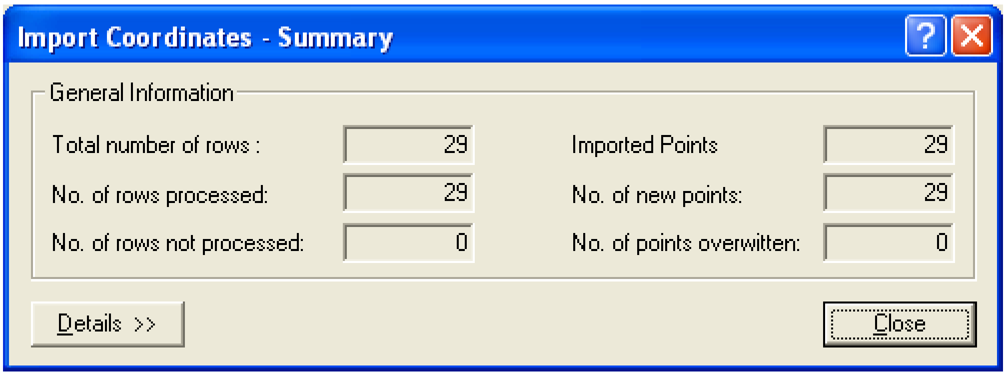
Import File

Import Coordinate File

The points can be imported from a formatted ASCII file (e.g. *.koo, *.xyz, *.csv, *.txt). The format can be selected from the list of existing formats or edited to suit the file to be imported. The Point ID and coordinates can be imported.

Follow these steps to import a Coordinate File.

Step	Action
1	Select the menu **Configuration**, **Point Editor...**, **or click** the toolbar **Points button** .
2	The **Point Editor** dialog will be displayed.
3	Click the **Import Coordinate File... button**.
4	The **Open Point File** dialog will be displayed.
5	Select the file to be imported and select the required import **Format** required. Enter a coordinate **Offset** to be added to the imported coordinates, if required. **Format:** Example: The *.koo file has by default the following format: %1_10p%30_40x%42_52y%54_63z. The **Point ID** is read from the position 1 to 10, the X coordinate (math. axis) or Easting coordinate (%x) from position 30 to 40, the Y coordinate (math. axis) or Northing coordinate (%y) from the position 42 to 52 and the Z coordinate (math. axis) or Height coordinate (%z) from the position 54 to 63. **Note**: It is not possible to change the %x and %y in the mask, but it is possible to change the positions. The *.xyz, *.csv, *.txt file has the following format: %p,%x,%y,%z. The values are read in the following order Point ID (%p), X coordinate (%x), Y coordinate (%y), Z coordinate (%z). The values are separated with a comma. The X, Y and Z are related to mathematical axis and can be converted similar to the given example above.

	For newly imported points the following settings are standard: No Profile, standard Limit Class, Additive Constant = 0 and Reflector Height = 0. **Offset:** If it is necessary to add an offset to the imported coordinates the offset values can be entered in the available Offset fields. If the imported coordinates are in the same coordinate system as the defined in the system, then these offsets will normally be zero.
6	Click the **Open** button to import the file.
7	An **Import Point** message box will be displayed to ask if existing points should be overwritten. Existing points can be overwritten or skipped with the following options: Overwrite, Overwrite All, Skip, Skip All or Cancel.
8	The **Open Point** File will be closed.
9	The **Import Summary** will be displayed. 
10	Click the **Close** button. The **Import Summary** dialog will be closed and the imported points will be shown in the table.

Import GSI File

Follow these steps to import a GSI File.

Step	Action
1	Select the menu **Configuration**, **Point Editor...**, **or click** the toolbar **Points button** .
2	The **Point Editor** dialog will be displayed.
3	Click the **Import GSI File... button**.

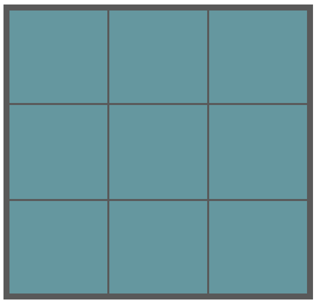
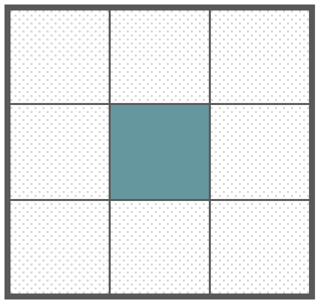
4	The **Import GSI File** dialog will be displayed.
5	Select the GSI file and press **OK** to import the points.

Measurement Modes

Please note the following important points when choosing the **Measurement Mode** (Messmode) in the Point Editor:

Measurement Mode	Description
Distance (IR)	The system will only measure the slope distances using the infra-red EDM (angles are recorded as well but will be very inaccurate). In this situation points are not in the range of the ATR or are being measured with an instrument without ATR functionality. This mode makes sense if you are only interested in distance measurements. With accurate distances you can detect movements only in the direction of the distance measurement. The system follows the point movements only with a simple search function. For the system to follow a point, the search window in the point group editor must be greater than 0.
Distance (LO)	As with Distance (IR) except the visible red laser EDM is used.
	Notes: ▪ Distance (IR) and Distance (LO) should not be mixed with ATR and Signal Scan measurement modes. A sensor should user either Distance measurement or ATR/Signal Scan for all points that it measures. ▪ For Distance (IR) and Distance (LO) measurement the TPS Properties: Calculations of the Sensor Location Editor the Coordinate Calculation should be set to **Only measured distance** and the Distance Reduction to **Using End Heights**. Otherwise invalid results will be calculated. Refer to the Distance Only Measurement Mode technical description for further details.
ATR	**A**utomatic **T**arget **R**ecognition ATR is the sensor which recognises and measures the position of a prism by means of a CCD array. A laser beam is transmitted and the reflected beam is received by the built in CCD array. The position of the reflected spot with respect to the centre of the CCD is computed. These ATR offsets are used to correct the horizontal and vertical angles. The ATR offsets are also used to control the motors which turn the instrument to centre the crosshairs to the prism. With a Total Station the system can follow the movement of points by measuring

<table>
<tr><td></td><td>with the ATR. Using ATR real 3D monitoring of the points is conducted. This mode can only be used if the Total Station supports the ATR mode (TCA and TCRA instruments).</td></tr>
<tr><td>ATR (Small field of view)</td><td>The field of view of the ATR in some Leica instruments can be reduced to help prevent ATR detection of multiple reflectors when the prisms are closely spaced, which often occurs in tunnel monitoring. The ATR (small field of view) reduces the viewing field of the ATR.

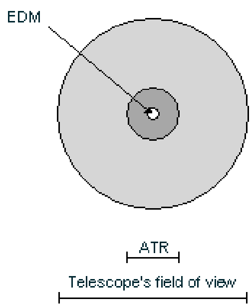
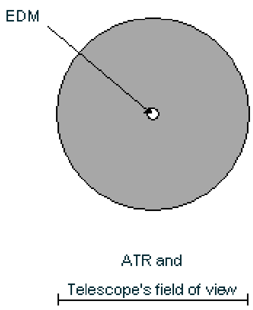

CCD of a normal ATR

CCD of small field of view ATR

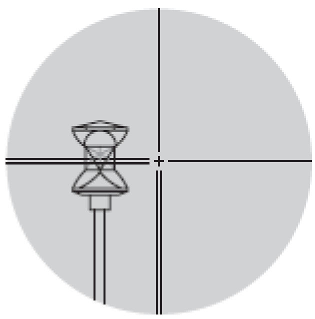
The small field of view feature in not available in all instruments. The fields of view of Leica total stations are as follow:

<table>
<tr><th>Instrument Series</th><th>Telescope field of view

The telescope field of view is the region seen when looking through the telescope.</th><th>Telescope & ATR</th><th>ATR field of view

The ATR field of view is the ATR.</th></tr>
</table>
</td></tr>
</table>

TPS 1000 Series (TCA1800/2003)	1° 33'		▪ Normal ATR has a ▪ Small field of view view of 10'.
TM30	1° 30'		▪ Normal ATR has a ▪ Small field of view view of 9.4'.
TPS 1100 Series	1.5°		▪ Normal ATR has a same as the telesc ▪ **Small field of view available.**
TPS 1200 Series	1.5°		▪ Normal ATR has a same as the telesc ▪ Small field of view view of one third of (approx. 30').
TS30	1° 30'		▪ Normal ATR has a 30'. ▪ Small field of view view of 30'.



ATR measurement

If the reflector is in the ATR field of view the crosshairs are automatically positioned to the reflector and a measurement is done. No ATR search is started. The displayed values are always related to the centre of the prism after a measurement is done. The crosshairs of the telescope may not fully coincide with

	the centre of the prism when viewed through the telescope. The remaining ATR offsets for the horizontal and vertical angles are measured by the ATR sensor and applied to the measured and displayed angles. The search window in the point group editor dialog is used to define the ATR search window. **Hint:** The search window values in the point group editor dialog can be used together with the point blunder check to help prevent measurements to the wrong points. **ATR Normal, ATR Low Vis and ATR automatic -** (TM30/TS30 only) Different ATR modes help to increase the measurement reliability during suboptimal weather conditions. ▪ **Normal**: The measuring ability during normal weather conditions is ensured. ▪ **Low Vis**: The measuring ability during suboptimal weather conditions (e.g. fog, rain) is increased. ▪ **Automatic**: Combination of the Normal and Low Vis ATR modes within GeoMoS Monitor. The measuring ability is increased in all weather conditions and distances. By default the GeoMoS software attemps measurements in both modes, Normal and Low Vis ATR.
Reflectorless	In this mode you can work with a Total Station that supports the reflectorless measurements of a point (TCRA1101plus, TCRA120x). Reflectorless measurement does not require a prism but the total station is not able to track a discrete point.
SignalScan (IR)	This mode used the return strength of the infra red electronic distance meter (IR EDM) to find the centre of the prism. A scan is made to find the edges of the signal above, below, left and right of the prism which are then used to calculate the position of the centre of the prism for the angle measurements.
SignalScan (LO)	As with Signal Scan (IR) except the visible red laser EDM (referred to as LO) is used.
	Notes: ▪ Using Signal Scan the angle accuracy is much less accurate than with ATR mode and depends on the atmospheric conditions. The signal scan only makes sense if the distance to a point is outside of the ATR range. ▪ For Signal Scan you must ensure that the total station is in the GeoCOM Online mode for the angles and distance to be measured correctly.

	Refer to the Signal Scan Measurement Mode technical description for further details.
ATR w/o Distance	In this measurement mode only angles are measured.

Notes:

- For **ATR**, **ATR (small field of view)**, **Reflectorless**, **Signal Scan (IR)** and **Signal Scan (LO)** measurement the TPS Properties: Calculations of the Sensor Location Editor the Coordinate Calculation should be set to **Full measurement** and the Distance Reduction to **Using Vertical Angles**. Otherwise invalid results will be calculated.

Point Group Editor

Point Group Editor

Background information

A point group can be created using individual points of profiles. Point group can be scheduled at set time in the measurement cycle and are used as the basis for the tree view in the Analyzer application for viewing points. Point groups can also be used to visualize the movement of total station control points.

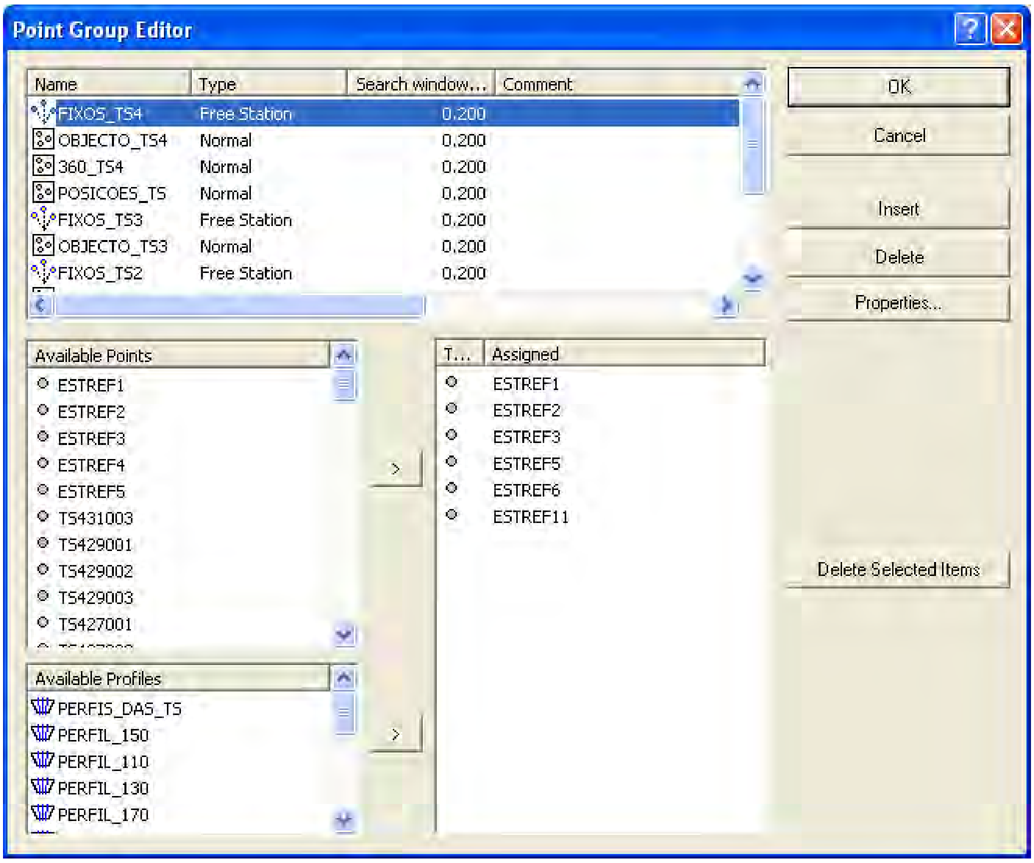
To open the Point Group Editor

Follow these steps to open the Point Group Editor.

Step	Action
1	Select the menu **Configuration**, **Point Group Editor...** or click the toolbar **Point Group button**  or press the **Point Groups...** button in the **Measurement Cycle Editor** dialog.
2	The **Point Group Editor** dialog will be displayed.
3	Press the **Insert** button.
4	A new line appears in the table. The table values can be edited by double clicking on the value.
5	Enter the Name, select a Type from the list and enter the size of the Search Window, if necessary.
6	Define the contents of the point group by "dragging and dropping" selected points and/or profiles from the respective lists of points and profile to the point group list.
7	Confirm the entered data and changes with the **OK** button.
8	The dialog will be closed and the defined point groups will be saved in the database.

Note: The above description guided you through the creation process by describing the minimum settings only.

Read below or click on the Point Group Editor Image to learn about all properties in detail



The table below describes the fields and buttons in the Point Group Editor dialog box.

Field/Button	**Description**
Name	The name of the point group.
Type	A point group can have one of the following types. ▪ Normal, Special, FreeStation, Distance Intersection, PPM, Orientation Only, Vz Correction **Type Normal** A maximum of two point groups with the type Normal can be

defined perTotal Station. The Normal point groups have the following characteristics:

- A point group with the type "Normal" can be selected to measure continuously or at a specified interval. Only one point group with the Type "Normal" can be defined as continuous for each total station.
- A second point group with the type Normal can be defined with the same priority as a continuous point group. It will be measured at approximately the scheduled time, but without interrupting any other scheduled point group measurements. Therefore, this point group could be scheduled to measure with a **Search Window** greater than 0 and once per day, for example, to update the target point positions with a scan measurement if there has been any movement.
- The points and profiles in the point group should be ordered so that they reduce the Total Stations horizontal rotation necessary to measure the point sequence. This reduces the time taken to measure the point group and reduce the wear and tear on the Total Station motors. The Total Station coordinates will be re-determined and saved at the beginning of a point group with Type "Normal". The method used to update the control point coordinates is dependent on the settings in the Free Station Group Properties (if using a Free Station), the Distance Intersection Group Properties (if using Distance Intersection) or in the TPS Properties: GNSS Update of the Sensor Location Editor (if using GNSS).

Type Special

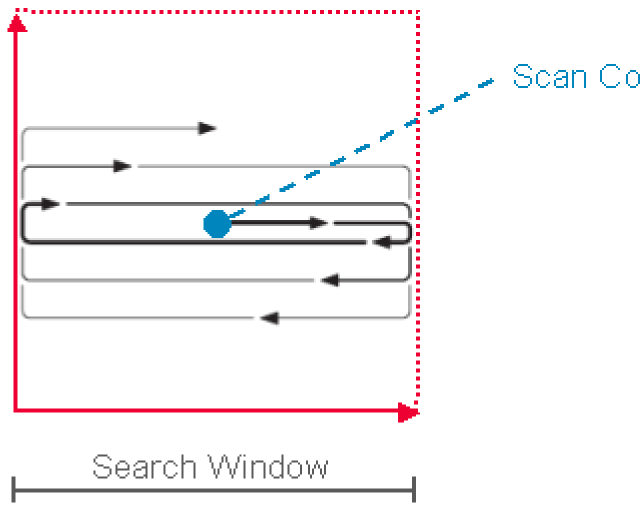
Point groups with the type "Special" have the next highest priority as point groups with type "Normal". A point group with the type "Normal will be interrupted during measurements if a point group with type "Special" is scheduled to be measured. The measurement of the point group with the type "Normal" will be continued after the point group that interrupted the

	measurements has finished measuring. **Type FreeStation** Point groups with the type "FreeStation" are used for the determination of the Total Station coordinates using both **distances** and **angle measurements**. These point groups should contain the fixed or stable points for determining the Total Station position. In the Free Station Group Properties dialog there are various options available for the automatic determination of the Total Station coordinates over a defined time period. The coordinate solutions of the "FreeStation" point group can be averaged over a defined time. (e.g. 24 hours). The automatic calculation of the Total Station coordinates can be turned on or off in the Free Station Group Properties dialog. The average of the Total Station coordinates using FreeStation solutions is only applied when the respective option is active in the **Properties** dialog. Before a point group with the type "Normal" is measured, the coordinates of the control point will be calculated and used for the reduction of measurements. If a point group with the type "FreeStation" is available in the measurement cycle, the respective option must be activated in the **Options** dialog before the control point coordinates are updated from the FreeStation solution. **Note**: One point should not be entered more than once in a Free Station group. **Warning**: Do only use points measured with the measurement mode ATR or ATR (small field of view) in the Free Station point group. If a point that is measured e.g. with Distance (IR) the measurement does not use the ATR to execute the measurement, but the system stores the angles of the telescope positioning to the database. These roughly stored angles decrease the accuracy of the Free Station computation. **Type Distance Intersection** Point groups with the type "Distance Intersection" are used for the determination of the Total Station coordinates using only

	distance measurements. These point groups should contain the fixed or stable points for determining the Total Station position. In the Distance Intersection Group Properties dialog there are various options available for the automatic determination of the Total Station coordinates over a defined time period. The coordinate solutions of the "Distance Intersection" point group can be averaged over a defined time. (e.g. 24 hours). The automatic calculation of the Total Station coordinates can be turned on or off in the Distance Intersection Group Properties dialog. The average of the Total Station coordinates using Distance Intersection is only applied when the respective option is active in the **Properties** dialog. Before a point group with the type "Normal" is measured, the coordinates of the control point will be calculated and used for the reduction of measurements. If a point group with the type "Distance Intersection" is available in the measurement cycle, the respective option must be activated in the **Options** dialog before the control point coordinates are updated from the "Distance Intersection" solution. **Note**: One point should not be entered more than once in a Distance Intersection group. **Type PPM** Point groups with the type "PPM" will be used to determine the atmospheric scale factor from measurement to the fixed or stable points contained in the point group. The PPM value is calculated from the ratio of calculated reference distances and actual measured distance. The new PPM value is used to correct the next measurements in the measurement sequence. For this correction to be applied a point group with the type "PPM" must be available in the measurement cycle and the respective Reference Distances option must be active in the **Options** dialog. To ensure that the PPM correction is computed reliably a number of measurement options are available in the PPM Group Properties. **Note**: Unstable points should not be added to the PPM group. **Relating topics:** Meteo Corrections

	Type Orientation Only Point groups with the type "Orientation Only" will be used to determine the orientation of the Total Station from measurements to the fixed or stable points contained in the point group. The Orientation is calculated using a robust least squares solution The new orientation value is used to correct the next measurements in the measurement sequence. For this correction to be applied a point group with the type "Orientation Only" must be available in the measurement cycle. See also orientation options available with the automatic FreeStation. To ensure that the orientation is computed reliably a number of measurement options are available in the Orientation Group Properties. **Note**: For every automatic deformation monitoring system it is very important to correct for changes in the orientation caused by movements of the pillar due to e.g. temperature differences. **Type Vz Correction** Point groups with the type "Vz Correction" will be used to determine the vertical circle angle correction from measurements to the fixed or stable points contained in the point group. The Vz Correction is an estimation of refraction calculated from coordinates of the Total Station control point and target points. Vz Correction = Vz Reference - Vz Actual The new Vz Correction value is used to correct the next V angle measurements in the measurement sequence. For this correction to be applied a point group with the type "Vz Correction" must be available in the measurement cycle. To ensure that the Vz correction is computed reliably a number of measurement options are available in the Vz Correction Group Properties. **Remarks:** The point groups with the type "Special" will be measured with a higher priority than point groups with the type "Normal". Point groups with the type "FreeStation" and "PPM" have the highest

<table>
<tr><td></td><td>priority and will be measured immediately and interrupt any existing point group measurements.</td></tr>
<tr><td>Search Window</td><td>The search window defines the maximum distance (see diagram below) from the target that the instrument will search for the reflector if it is initially not found. The search window depends on the distance between the total station control point and the target point. This feature is useful for when the reflector position is slowly moving.



If the reflector is not in the field of view when a point is measured and the Search Window is greater than zero, an search is started.

<table>
<tr><th>Measurement Mode</th><th>Description</th></tr>
<tr><td>ATR, ATR (small field of view)</td><td>For the ATR search the search window is scanned line by line starting at the scan coordinate. The reflector position will also be updated for the automatic instrument pointing position.</td></tr>
<tr><td>Distance (IR), Distance</td><td>For the search without ATR the search window is scanned with the EDM signal strength starting at the scan coordinate to find</td></tr>
</table>
</td></tr>
</table>

	<table><tr><td>(LO)</td><td>a prism in the search window. The reflector position will also be updated for the automatic instrument pointing position.</td></tr></table> **Note:** ▪ If the Search Window is set to zero, no search will be executed and the instrument will always point to the last measured position "current coordinate" to make the measurement. The "scan coordinate" is not updated. If the point moves then the system will no longer be able to measure the point. ▪ If the Search Window is too big, it is possible the search routine could find another point within the defined search window radius. To reduce the chances of pointing errors, it is possible to set a tolerance for Point Blunder Checks in the TPS Properties: Measurements dialog of the Sensor Location Editor. ▪ If the Search Window and the Point Blunder Check is set, the "scan coordinate" will be updated if the search routine was successful and the point blunder check was not exceeded.
Comment	This user defined comment may be used to record information about the group, such as which instrument is meant to measure it.

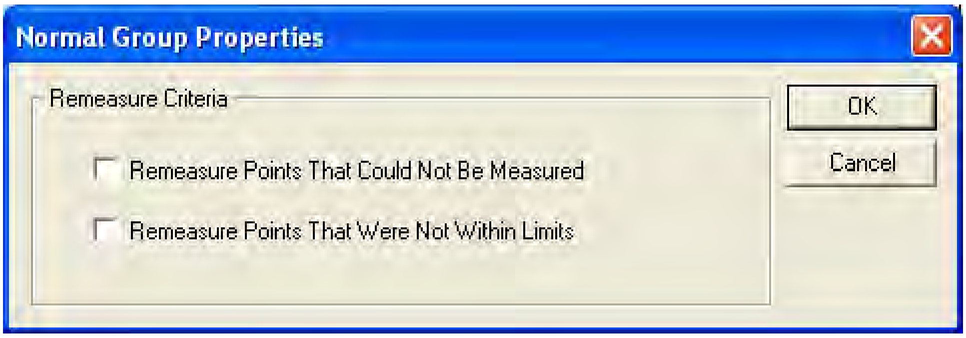
Drag and Drop	Select a point group from the list. Click on an available point or profile with the left mouse button and while holding the left mouse button down, drag the mouse over the **Assigned** window for the point group and release the left mouse button. Points and profiles can also be removed from the **Assigned** window for the point group using the same drag and drop technique. The order of points and profiles within the point group list defines the sequence order of the measurements. The re-ordering of the list can also be done with the drag and drop technique. The sequence of points within a profile is defined alphabetically by the Point ID and cannot be ordered independently. A point or profile can be assigned to a point group more than once. As many point groups as required can be defined. A point or profile

	can be assigned to more than one point group. The point group is only measured if it is defined in the measurement cycle.
Available Points	A list of all points.
Available Profiles	A list of all profiles. If you add a profile to a point group, then all points in that profile will be included in the point group.
Assigned	The list of all points and profiles in the currently selected point group.

Insert	Adds a new point group line and the fields can be defined by double clicking in the field.
Delete	The selected point groups in the table will be deleted. A point group can only be deleted if it is no longer used in the measurement cycle. Point groups can be removed from the measurement cycle in the Measurement Cycle Editor dialog. Only the point group information is deleted. The points and profiles contained in the point group are not deleted.
Properties...	Opens the properties dialog for the selected point group. For more information click on the appropriate heading: ▪ Properties: Normal Group ▪ Properties: Free Station ▪ Properties: Distance Intersection ▪ Properties: PPM ▪ Properties: Vz Correction ▪ Properties: Orientation
Delete Selected Items	Removes the selected points or profiles from the point group.

Properties: Normal Group

Remeasure Criteria

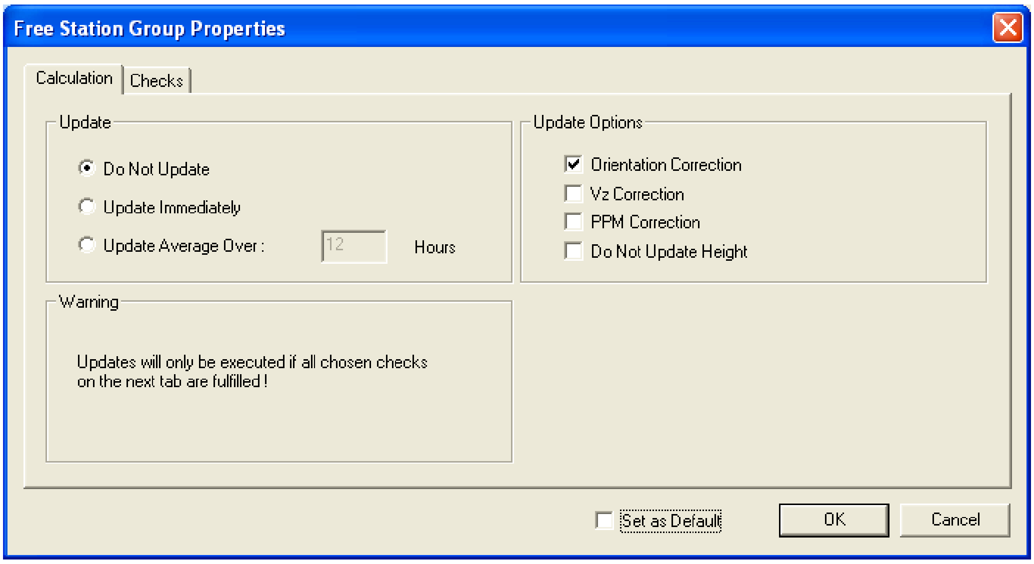


The table below describes the fields in the Normal Group Properties dialog box.

Field	Description
Remeasure Criteria	
Remeasure Points that could not be measured	If this option is selected then the system will re-attempt to measure any points that could not be measured at the end of the Normal group. Only a single attempt will be made to re-measure the points.
Remeasure Points that were not within limits	If this option is selected then the system will re-attempt to measure any points that were outside the tolerances specified in the TPS Properties: Measurements dialog of the Sensor Location Editor. Only a single attempt will be made to re-measure the points.

Properties: Free Station

Calculation



The table below describes the fields in the Free Station Group Properties: Calculation tab dialog box.

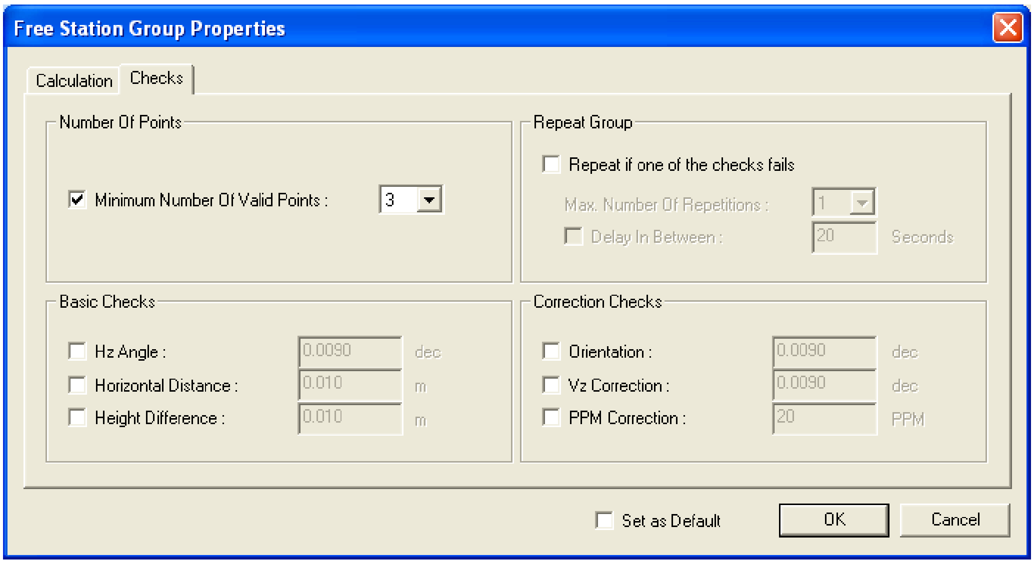
Field	Description
Update	
Do not update	The station coordinates will be calculated, but the Total Station coordinates will not be updated.
Update immediately	The station coordinates will be calculated and the Total Station coordinates updated immediately with the computed values.
Update Average Over	The station coordinates will be calculated and a median of all Free Station results of the last defined period will be used to update the Total Station coordinates.

Update Options	
Orientation Correction	In addition to the Total Station coordinates, the orientation of the total station will be calculated and updated.
Vz Correction	In addition to the Total Station coordinates, the Vz correction will be calculated and updated.
PPM Correction	In addition to the Total Station coordinates, the PPM correction will be calculated and updated.
Do not update height	If this option is selected then only the horizontal coordinates (Easting and Northing) will be updated, not the Height.

Note:

- Updates are only executed if all chosen checks on the **Checks tab** are fulfilled!
- The **Update Options** (Orientation, Vz and PPM Correction) are updated if all chosen checks on the **Checks tab** are fulfilled regardless of which **Update scenario** (Do not update, Update immediately or Update Average Over) is selected.
- Free Station should not be combined with the Distance Intersection Point Group or GNSS Update (in the Sensor Location Manager). Only one method for updating the station coordinates should be used for a given total station.

Checks



The table below describes the fields in the Free Station Group Properties: Checks tab dialog box.

Field	Description
Number of Points	
Minimum Number of Valid Points	The minimum number of points that must be successfully measured before the corrections will be computed and applied. The purpose of this option is to prevent jumps caused by different measurement geometry.

Basic Checks	
Hz Angle	The maximum accepted standard deviation of the horizontal angles for the result to be calculated and applied.
Horizontal Distance	The maximum accepted standard deviation of the horizontal distances for the result to be calculated and applied.
Height Difference	The maximum accepted standard deviation of the height differences for the result to be calculated and applied.

Repeat Group	
Repeat if one of the checks fails	If check, this option will cause the system to re-measure the point group if one of the above checks fails.
Max. Number of Repetitions	This setting defines the number of times the system will re-measure the point group if the above checks continue to fail.
Delay between Cycles	This setting defines the delay between the re-tries. The purpose of this setting is to allow time for a temporary obstruction to be moved allowing the system to measure all of the points in the group.

Correction Checks	
Orientation	This option sets the maximum accepted standard deviation for the Orientation calculation. If the estimated standard deviation worse than this figure than the correction will not be applied.
Vz Correction	This option sets the maximum accepted standard deviation for the Vz Correction calculation. If the estimated standard deviation worse than this figure than the correction will not be applied.
PPM Correction	This option sets the maximum accepted standard deviation for the PPM Correction calculation. If the estimated standard deviation worse than this figure than the correction will not be applied.

Set as Default	Check this option for the setting entered for this sensor to be the default for all new point groups of this type that are created.

Properties: Distance Intersection

Calculation

The table below describes the fields in the Distance Intersection Properties: Calculation tab dialog box.

Field	Description
Update	
Do not update	The station coordinates will be calculated, but the Total Station coordinates will not be updated.
Update immediately	The station coordinates will be calculated and theTotal Station coordinates updated immediately with the computed values.
Update Average Over	The station coordinates will be calculated and a median of all Free Station results of the last defined period will be used to update the Total Station coordinates.

Update Options	
Orientation Correction	In addition to the Total Station coordinates, the orientation of the total station will be calculated and updated.
Vz Correction	In addition to the Total Station coordinates, the VZ correction will be calculated and updated.
PPM Correction	In addition to the Total Station coordinates, the PPM correction will be calculated and updated.
Do not update height	If this option is selected then only the horizontal coordinates (Easting and Northing) will be updated, not the Height.

Note:

- Updates are only executed if all chosen checks on the **Checks tab** are fulfilled!
- The **Update Options** (Orientation, Vz and PPM Correction) are updated if all chosen checks on the **Checks tab** are fulfilled regardless of which **Update scenario** (Do not update, Update immediately or Update Average Over) is selected.
- Distance Intersection should not be combined with the Free Station Point Group or GNSSUpdate (in the Sensor Location Manager). Only one method for updating the station coordinates should be used for a given total station.

Checks

The table below describes the fields in the Distance Intersection Properties: Checks tab dialog box.

Field	Description
Number of Points	
Minimum Number of Valid Points	The minimum number of points that must be successfully measured before the corrections will be computed and applied. The purpose of this option is to prevent jumps caused by different measurement geometry.

Basic Checks	
Hz Angle	The maximum accepted standard deviation of the horizontal angles for the result to be calculated and applied.
Horizontal Distance	The maximum accepted standard deviation of the horizontal distances for the result to be calculated and applied.
Height Difference	The maximum accepted standard deviation of the height differences for the result to be calculated and applied.

Repeat Group	
Repeat if one of the checks fails	If check, this option will cause the system to re-measure the point group if one of the above checks fails.
Max. Number of Repetitions	This setting defines the number of times the system will re-measure the point group if the above checks continue to fail.
Delay between Cycles	This setting defines the delay between the re-tries. The purpose of this setting is to allow time for a temporary obstruction to be moved allowing the system to measure all of the points in the group.

Correction Checks	
Orientation	This option sets the maximum accepted standard deviation for the Orientation calculation. If the estimated standard deviation worse than this figure than the correction will not be applied.
Vz Correction	This option sets the maximum accepted standard deviation for the Vz Correction calculation. If the estimated standard deviation worse than this figure than the correction will not be applied.
PPM Correction	This option sets the maximum accepted standard deviation for the PPM Correction calculation. If the estimated standard deviation worse than this figure than the correction will not be applied.

Set as Default	Check this option for the setting entered for this sensor to be the default for all new point groups of this type that are created.

Properties: Vz Correction

Checks

The table below describes the fields in the Vz Correction Properties: Checks tab dialog box.

Field	Description
Minimum Number of Valid Points	The minimum number of points that must be successfully measured before the Vz Correction will be computed and applied. The purpose of this option is to prevent jumps caused by different measurement geometry.
Tolerance Standard Deviation	This option sets the maximum accepted standard deviation for the Vz Correction calculation. If the estimated standard deviation worse than this figure than the correction will not be applied.

Repeat Group

The table below describes the fields in the Vz Correction Properties: Repeat Group tab dialog box.

Field	Description
Repeat if one of the checks fails	If check, this option will cause the system to re-measure the point group if one of the above checks fails.
Max. Number of Repetitions	This setting defines the number of times the system will re-measure the point group if the above checks continue to fail.
Delay between Cycles	This setting defines the delay between the re-tries. The purpose of this setting is to allow time for a temporary obstruction to be moved allowing the system to measure all of the points in the group.

Properties: Orientation

Checks

The table below describes the fields in the Orientation Properties: Checks tab dialog box.

Field	Description
Minimum Number of Valid Points	The minimum number of points that must be successfully measured before the Orientation Correction will be computed and applied. The purpose of this option is to prevent jumps caused by different measurement geometry.
Tolerance Standard Deviation	This option sets the maximum accepted standard deviation for the Orientation Correction calculation. If the estimated standard deviation worse than this figure than the correction will not be applied.

Repeat Group

The table below describes the fields in the Orientation Properties: Repeat Group tab dialog box.

Field	Description
Repeat if one of the checks fails	If check, this option will cause the system to re-measure the point group if one of the above checks fails.
Max. Number of Repetitions	This setting defines the number of times the system will re-measure the point group if the above checks continue to fail.
Delay between Cycles	This setting defines the delay between the re-tries. The purpose of this setting is to allow time for a temporary obstruction to be moved allowing the system to measure all of the points in the group.

Properties: PPM

Checks

The table below describes the fields in the PPM Properties: Checks tab dialog box.

Field	Description
Minimum Number of Valid Points	The minimum number of points that must be successfully measured before the PPM Correction will be computed and applied. The purpose of this option is to prevent jumps caused by different measurement geometry.
Tolerance Standard Deviation	This option sets the maximum accepted standard deviation for the PPM Correction calculation. If the estimated standard deviation worse than this figure than the correction will not be applied.

Repeat Group

The table below describes the fields in the PPM Properties: Repeat Group tab dialog box.

Field	Description
Repeat if one of the checks fails	If check, this option will cause the system to re-measure the point group if one of the above checks fails.
Max. Number of Repetitions	This setting defines the number of times the system will re-measure the point group if the above checks continue to fail.
Delay between Cycles	This setting defines the delay between the re-tries. The purpose of this setting is to allow time for a temporary obstruction to be moved allowing the system to measure all of the points in the group.

Measurement Cycle Editor

Background information

The measurement cycle automatically measures a defined configuration of different point groups. The frequency of measurements can be defined by setting the start time, interval and end time for each point group. The measurement process must be stopped to define a new measurement cycle or change the existing cycle.

Remark:

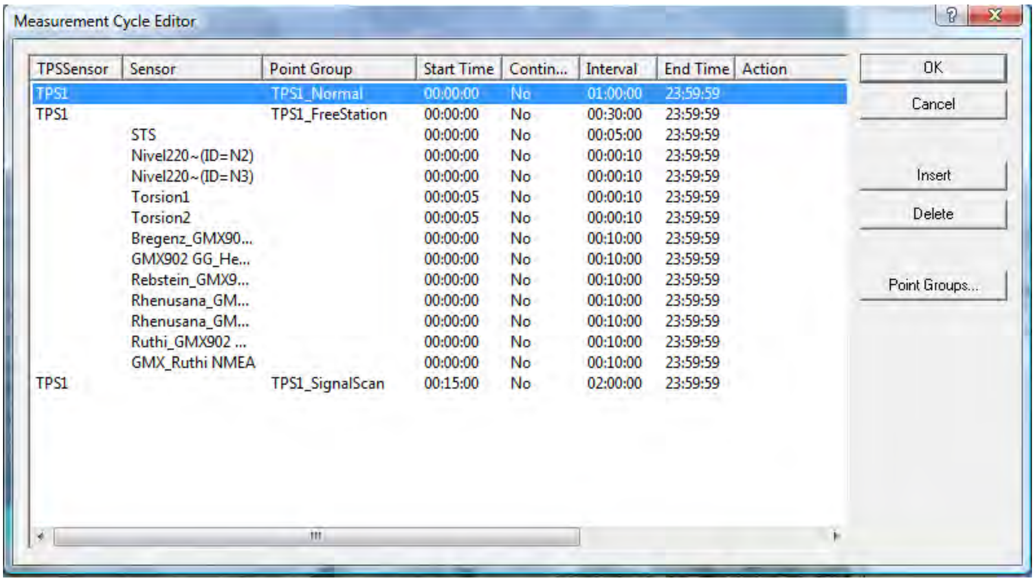
When defining a measurement cycle, take care not to overburden the system. Definition of too many point groups can complicate the measurement cycle and make the overview and the time scheduling complicated. Complicated or overlapping time schedules can create measurement jams in the system and cause certain point groups to be omitted from the measurement cycle. The system cannot warn of overlapping measurement processes because the time of a single measurement is not exactly known. Measurement time is dependent on external factors including atmospheric conditions, fog and sun intensity and the type of instrument that is used.

To open the Measurement Cycle Editor

Follow these steps to open the Measurement Cycle Editor.

Step	Action
1	Select the menu **Configuration**, **Measurement Cycle Editor...** or click the toolbar **Measurement Cycles button** .
2	The **Measurement Cycle Editor** dialog will be displayed.
3	Press the **Insert Measurement** button to insert a new measurement line.
4	Select the Sensor with which the point group should be measured.
5	Select the desired point group from the list.
6	Enter the required measurement information for the selected point group.
7	Select the telescope position to use for the measurements (ie. Pos **I** or Pos **I** & **II**).
8	Confirm with the **OK** button. The dialog will be closed and the new measurement cycle will be saved in the

	database. The new measurement cycle will be activated when the automatic measurement cycle is started.



The table below describes the fields and buttons in the Measurement Cycle Editor dialog box.

Field/Button	**Description**
TPS Sensor	A Total Station can be selected from the choice list. The list displays the Total Station currently connected in the Sensor Manager. If no Total Station is shown in the list the Total Station connection must first be defined in the Sensor Manager dialog and then the Sensor must be assigned to a set-up point in the Sensor Location Editor.
Sensor	Any non-TPS sensor (such as a GNSS, Nivel20/200, Combined Temperature/Pressure sensor etc.) can be selected from the list. The list displays the non-TPS Sensors currently connected in the Sensor Manager. If no Generic Sensor is shown in the list the Generic Sensor connection must first be defined in the Sensor Manager dialog and then the Sensor must be assigned to a set-up point in the Sensor Location Editor. **Note:** It is not possible to combine a Total Station and a Generic sensor in the same entry in the Measurement Cycle Editor.
Point Group	For Total Station a point group must be selected from the choice list containing the existing point groups. The **Point Group** button can be

	pressed to display the Point Group Editor and additional point groups can be defined. No point group is required for Generic sensors. **Note:** Points that are included in profiles and are assigned to a point group will be measured in alphabetical order.
Start Time	Defines the time when the point group will be measured for the first time. If no End Time is defined the point group will be measured between Start Time and midnight.
Continuous	Only point groups with the type **Normal** can be set to measure continuously. After the last point in the point group is measured, the measurements will continue from the first point, without pausing. A point group with a type other than Normal has a higher priority and will interrupt the continuous cycle to measure the point group and, on completion, will return to the continuous measurements. For each total station only one point group (type Normal) can be set to measure continuous.
Interval	The interval defines the time period, calculated from the start time, at which the point group will be repeatedly measured. For example, if an Interval of 4 hours is entered, the point group will be repeatedly measured every 4 hours starting from the start time. It is recommended that the Interval is entered as an even fraction of a day, so that the measurements always occur at the same time of day. If an Interval is defined the "Continuous" option will be set to "No". **Note:** • Spider RT Positioning Product: The interval defines the time a RT Positioning Product is stored to the database. The received RT Positioning Product results are averaged over the defined interval. • Spider PP Positioning Product: The interval defines the time a PP Positioning Product is retrieved out of the Spider Positioning database. If a new valid PP Positioning Product is available it will be processed by GeoMoS. • Campbell datalogger: The interval defines the time a Campbell datalogger field is read out to GeoMoS monitor. The received results are all stored to the database.
End Time	When the End Time is defined, the point group will be measured

	between the Start and End Time with the defined Interval. The End Time can be turned off, with the time value 23:59:59. When the End Time is turned off the point group will be measured until midnight and start again at the Start Time. **Hint:** How can a point group be measured once a day? Enter the start time at which the point group should be measured. Enter an interval of e.g. 2 hours and select an end time 1 hour after the start time. The point group will be measured only once a day.
Telescope Position	For Total Station it is possible to measure in a single face/telescope position (i.e. Pos 1) or in both faces/telescope positions (Pos 1-2, 2-1). For measurements in both positions, the first point will be measured in the first position and then the second position. The second point is measured in the second position and then the first position. The next point will be measured in the first position and then the second position and so for the following points. For measurements in both positions and repeat measurements GeoMoS Monitor will compute an average for all face 1 and all face 2 observations and store only this average into the database. In addition the result of the face 1 and face 2 is computed and stored to the database.
Action	Actions can be added to be run after the measurement of the point group is finished (e.g. an application can be started) or in a defined time interval. Actions are pre-defined in the Message Configurator or in the service dialogs (e.g. Webcams, Data Push to GeoMoS Web, Export Service to GeoMoS Adjustment) **Note:** ▪ There will be no message if the application is not available. ▪ It is possible to have an action scheduled independently of a sensor.
Comment	A comment can be entered for the measurement cycle.

	Adds a new entry in the measurement cycle.

Delete	The selected measurements in the table will be deleted from the measurement cycle.
Point Groups...	The Point Group Editor will be displayed.

Related Topics:

Automatic Measurement

Point Group Measurement Priority

Limit Class Editor

Background information

The limit checks functionality is license protected. This functionality can be purchased with GeoMoS Monitor Option 2 (article number 774 136). Please contact your Leica representative.

The point displacement can be indicated with defined tolerances. Every point can be assigned an individual limit class. The limit class defines the allowable tolerance for point displacement. When a tolerance defined in a limit class is exceeded a limited exceeded status message will be sent. Four **limit types** can be tested:

- Absolute Limit Check
- Short Time Limit Check
- Long Time Limit Check
- Regression Limit

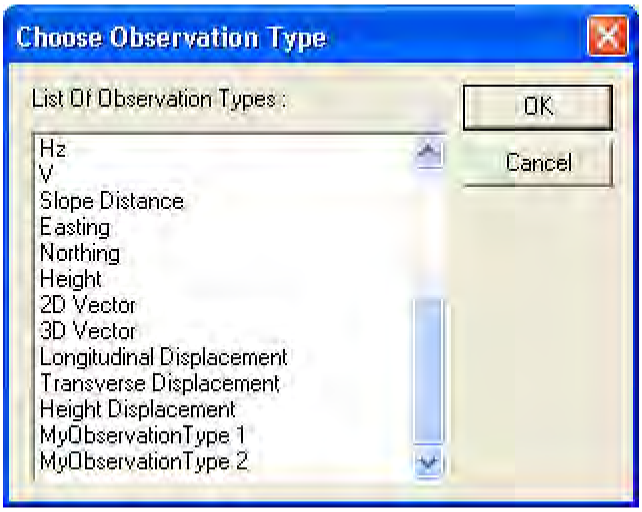
The tolerances are defined in the **Limit Class Editor**. Every point can be assigned an individual limit class. As many Limit Classes as required can be defined. Each limit class can contain checks on five different **observation types**.

Each limit check type has three different levels. Use the different levels to generate warnings at different threshold levels.

To open the Limit Class Editor

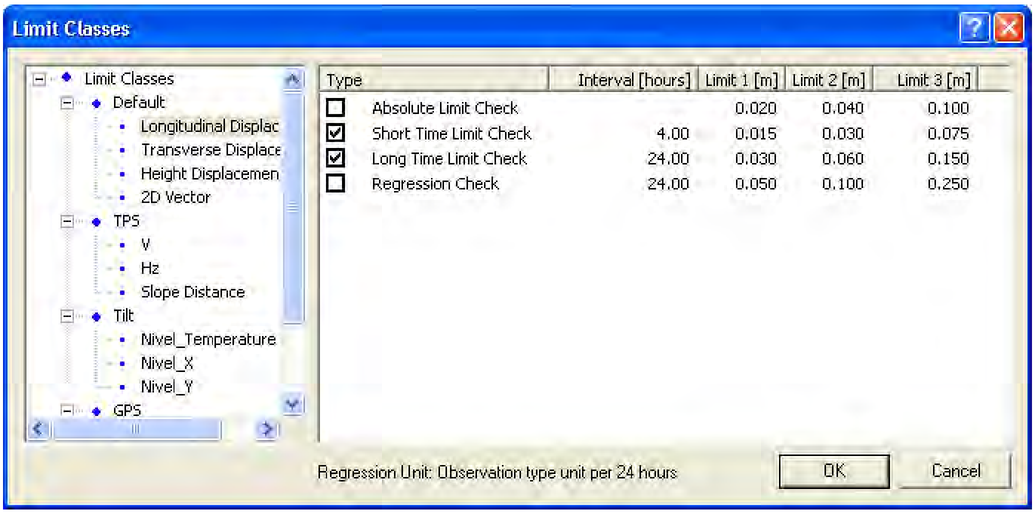
Follow these steps to open the Limit Class Editor.

Step	Action
1	Select the menu **Configuration**, **Limit Class Editor...** or click the toolbar symbol for **Limit Classes** or select **Limit Class Editor** in the **Point Editor** dialog.
2	The **Limit Class Editor** dialog will be displayed.
3	Right click on Limit Classes in the tree view and choose **Add Limit Class**. Enter the name of the new limit class and continue with **OK**. The new limit class will be shown

	in the tree view.
4	Right click on the new limit class and choose **Add Observation Type**.  Select the observation that you would like to make a limit check on from the list. The new observation type will be shown in the tree view under the limit class that you created. It is possible to select standard system observation types and user defined observation types.
5	Select the **Type** from the list. In the right hand window will be shown the four limit check types.
6	**Activate the types of limit checks you wish to make on this observation type. Enter the tolerance and time values for the limit check.**
7	Repeat steps 3 through 6 for all different limit classes and observation types.
8	Confirm the entry with **OK**.
9	The dialog will be closed and the new limit classes will be saved in the database.

Note: The above description guided you through the creation process by describing the minimum settings only.

Read below to learn about all properties in detail.



The table below describes the fields in the Limit Classes dialog box.

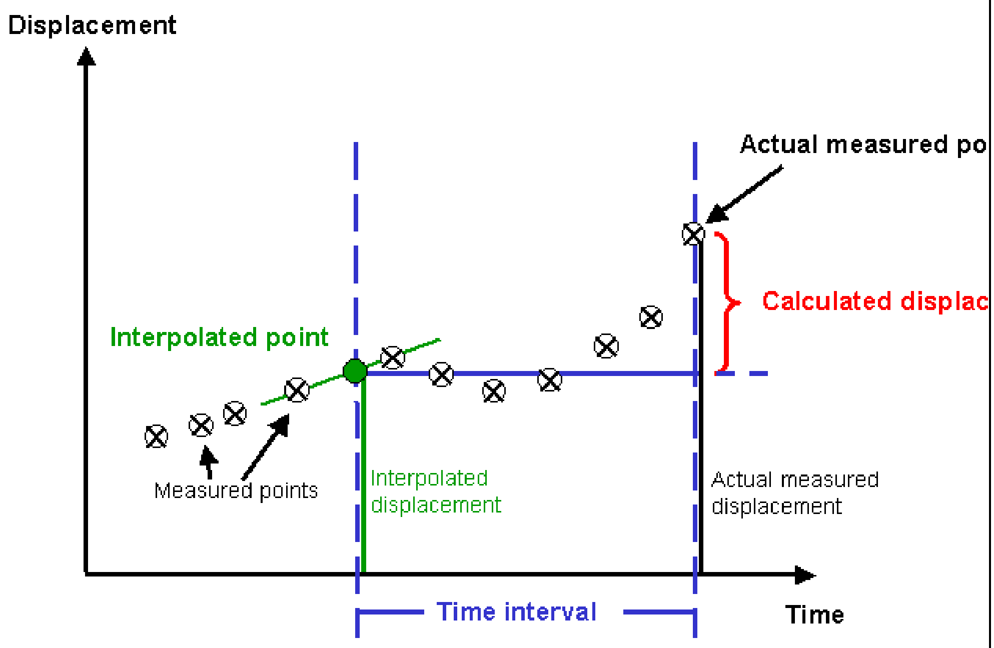
Field	**Description**
Tree View	The tree view contains a list of all limit classes configured in the system. Under each individual limit class are shown the observation types that have been created for that class.

Limit Check Window	
Type	The type of limit check to be computed. The check box is used to activate and deactivate each limit check type. **Absolute Limit Check:** A limit check that compares the value of the observation to an absolute number. Example: The absolute limit check level 1 is set to 0.05 m for a point. Then point moves from the original position (null coordinate) to a new position (current coordinate). The absolute limit check is exceeded when the point is outside of the range -0.025 and +0.025 m.

Short Time Check / Long Time Check:

The short time limit is defined by a displacement value and a **time interval**. The displacement is calculated from the difference between the **actual measured displacement** and an **interpolated displacement** at an earlier time defined by the interval. The interpolated displacement lies between at least two actual measurements. The **calculated displacement** (difference between measurements) is compared to the tolerance limit defined in the limit class. A status message will be sent when the difference is greater than the tolerance limit.

Diagram short time / long time limit check:



Regression Check:

Similar to the short time and long time checks, except that a special smoothing algorithm is used in the computation of the **linear regression**.

The regression check is defined by a displacement value and a **time interval**. The displacement is calculated from the linear regression between the measured points defined by the interval. The **calculated displacement** (difference between the intersections of the regression line and the time interval) is compared to the tolerance limit defined in the limit class. A status message will be sent when the difference is greater than the tolerance limit.

Notes:

- The time interval to calculate the regression line can be selected

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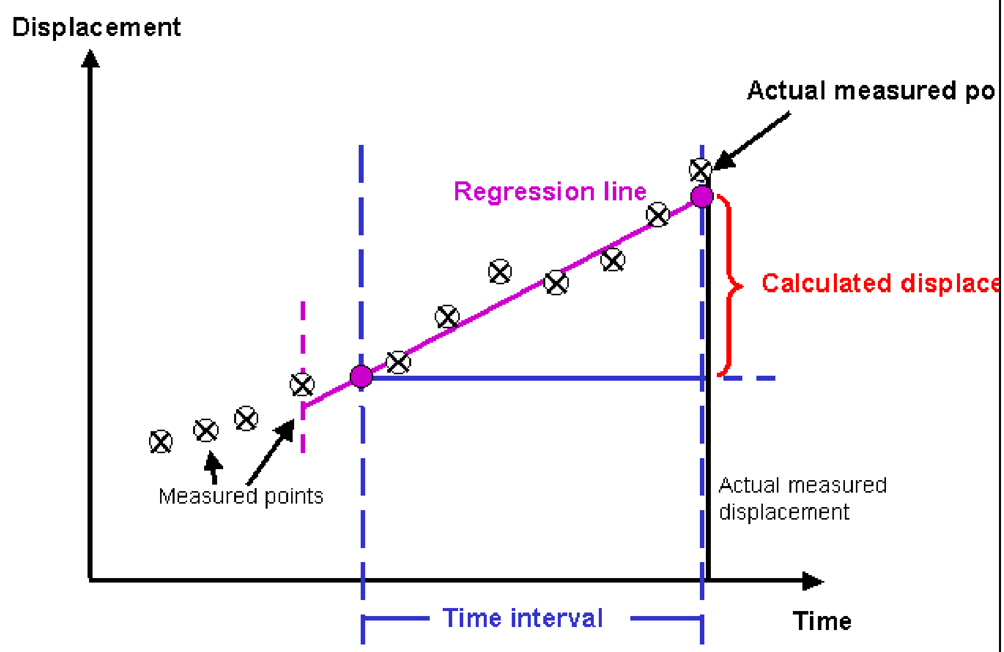
individually.
The regression tolerance limit of the observation type limit 1, limit 2 and limit 3 defined in the limit class is always related to 24 hours.
Diagram regression check:


</td>
</tr>
<tr>
<td>Interval Hours</td>
<td>
The amount of data to be used in the calculation.
<table>
<tr><td>Limit 1 [m]: The first level limit for the limit check.</td><td></td><td>yellow</td></tr>
<tr><td>Limit 2 [m]: The second level limit for the limit check.</td><td></td><td>orange</td></tr>
<tr><td>Limit 3 [m]: The third level limit for the limit check.</td><td></td><td>red</td></tr>
</table>
</td>
</tr>
</table>

	Important Note: If multiple limit checks of a measurement are exceeded simultaneously then only the highest limit level message will be displayed! Sometimes the three limit checks are not used competently (e.g. only limit level 1 and 2 are used and limit level 3 not). Therefore define an very high and nearly impossible limit value to the unused limit level 3. This causes that system will produce an action that is defined to the lower limit levels and not to the unused limit level.

To delete a limit class, right click on its name in the tree view and choose **Remove Limit Class**.

To rename a limit class, right click on its name in the tree view and choose **Rename Limit Class**.

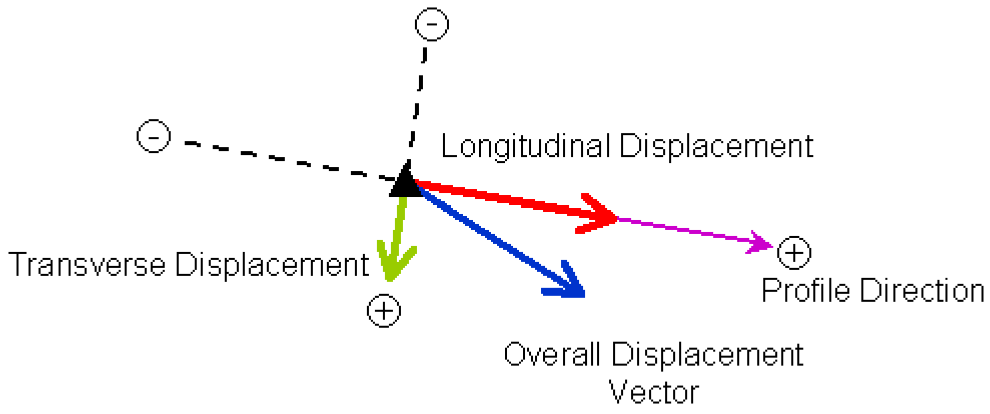
To delete an observation type, right click on its name in the tree view under the relevant limit class and choose **Remove**.

Profile Editor

Background Information

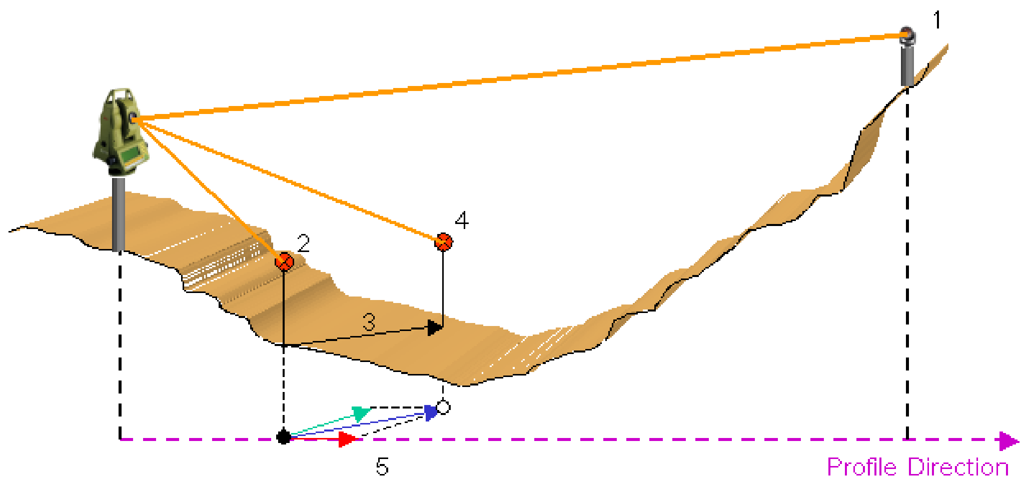
A profile defines the direction (i.e. azimuth) in which the displacement will be initially analyzed for the tolerance checks. Every point can be assigned to a selected profile which is used during the calculation of the displacement vector. Profiles can be assigned to points in the Point Editor dialog. The profile direction can be manually input or calculated between two existing points. The calculation of the displacement along the profile, perpendicular to the profile and in the vertical direction is dependent on the type of profile assigned to the point.

Definition



The **profile direction** defines the direction of the **longitudinal displacement**. The **transverse displacement** is orthogonal to the longitudinal displacement.

Example



The reference point up on the hill (1) was measured and used to define the **profile direction**. In the Point Editor dialog a monitoring point was insert and measured (2) with the Learn button. The coordinate types "Null", "Reference", "Current" and "Scan" are stored in the database. To detect movements this monitoring point was located in a unstable area and over the years the monitoring point moved (3) to the current position (4). With the automatic measurement cycle the point is measured and the displacements computed. The **longitudinal displacements** and the **transverse displacements** (5) are displayed on the Last Actions tab.

Standard profiles

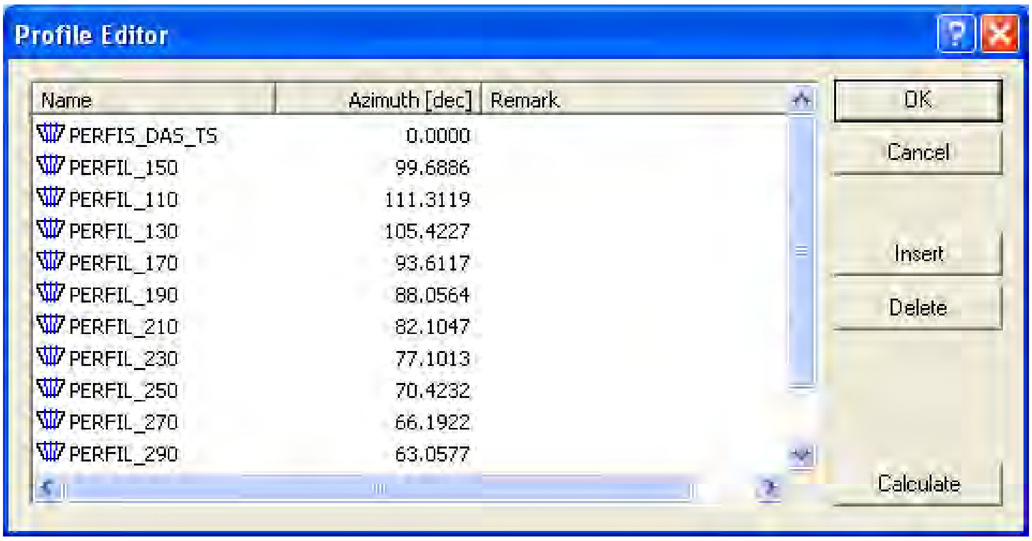
If in the Point Editor no profile is selected, then the standard profile will be used.

Total Station standpoints: The standard profile direction will be calculated from the station point to the north.

Total Station points: The standard profile direction will be calculated from the station point to the target point.

GNSS points: The standard profile direction will be calculated from the station point to the north.

Read below or click on the Profile Editor Image to learn about all properties in detail



The table below describes the fields and buttons in the Profile Editor dialog box.

Field/Button	**Description**
Name:	The Profile name is used to identify and select the Profile in the Point Editor, Point Group Editor and Reports.
Azimuth [unit]:	When the profile azimuth is edited, the new value will be used for all following calculations and measurements results. This will cause previous results calculated on the old azimuth to be inconsistent from all future results which will use the new azimuth, which may cause steps in the measurement data.
Remark:	A remark may be entered to describe the profile.

Insert...

Follow these steps to insert a manual Profile definition.

Step	Action
1	Select the menu **Configuration**, **Profile Editor...** or click the toolbar **Profiles button** .
2	The **Profile Editor** dialog will be displayed.
3	Press the **Insert** button and enter the Profile name for the new Profile in the table. The Profile name must be unique. A message will be displayed if the Profile name already exists.
4	Enter the azimuth value for the Profile direction. **Tip:** The sign of the deformations can be reversed by changing the profile direction by 180° or 200gon.
5	Confirm the entered data and changes with the **OK** button.
6	The dialog will be closed and the changes will be saved in the database.

Delete

The profiles selected in the table will be deleted. A profile cannot be deleted when it is still associated with a point or when it is used in a Point Group definition.

Calculate...

To calculate a profile follow these steps.

Step	Action
1	In the **Profile Editor** dialog, press the **Insert Profile button**.
2	Select the new Profile and press the **Calculate Selected Profile....** button.
3	The **Calculate Azimuth** dialog is displayed.

4	Select the **Start Point** and **End Point** for the Profile definition. The Profile azimuth will be calculated from the Start and end points and displayed in the dialog. Press the **Apply** button to accept the calculated profile azimuth. **Tip:** The sign of the deformations can be reversed by changing the profile direction by 180° or 200gon.
5	The **Calculate Azimuth** dialog will be closed and the calculated azimuth will be displayed in the table.
6	Confirm the entered data and changes with the **OK** button.
7	The dialog will be closed and the changes will be saved in the database.

Remarks:

If the coordinate Calculation method Only measured distance is selected in the Options dialog in the Calculation tab, the direction of the profiles should be approximately the same as the direction of the line of sight of the measurements. This measurement technique is highly dependent on the geometry of the measurement direction and the profile direction. When the geometry of the measurements and the monitoring network is not suited to this technique, the calculations and results will be inaccurate and subject to large variations.

Null Measurement Editor

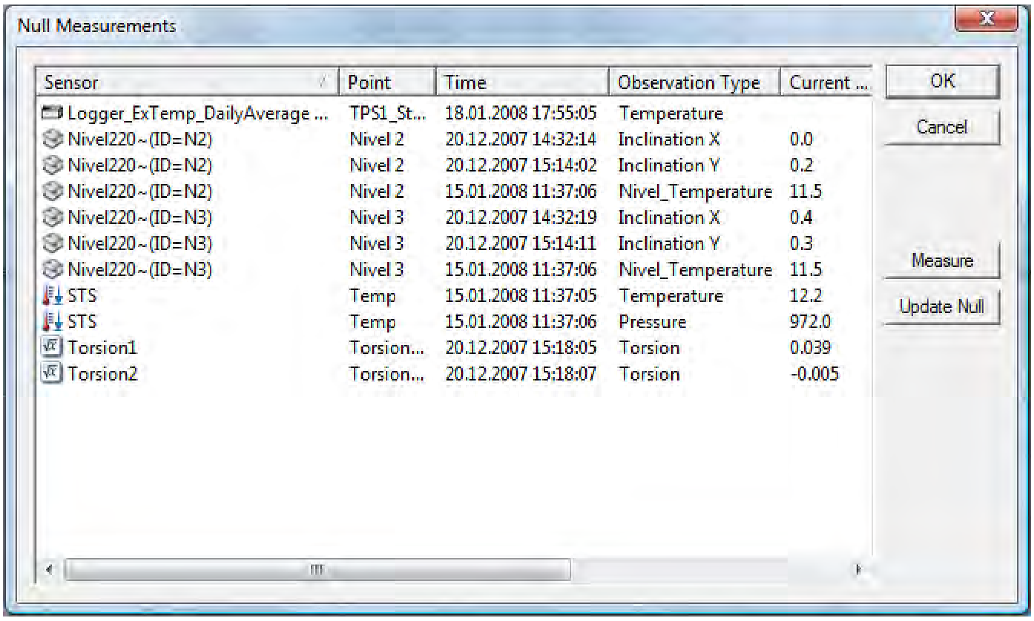
To open the Null Measurement Editor

Follow these steps to open the Null Measurement Editor.

Step	Action
1	Select the menu **Configuration**, **Null Measurement Editor...**.
2	The **Null Measurement Editor** dialog will be displayed. Each row shows one sensor or one observation type from a single sensor.
3	Select a sensor and press the **Measure** button to read out the current value.
4	Either manually enter the **Null Value** by right-clicking on the cell for that sensor/observation type and typing in the value, or use the **Update Null** button to set the null value to the current value. **Important:** Default Null Value = 0
5	Press the **OK** button to save the changes and to close the dialog.

Note: The above description guided you through the creation process by describing the minimum settings only. Please read the remainder of this topic for more detailed information.

Null Measurement properties



The table below describes the fields and buttons in the Null Measurements dialog box.

Field/Button	Description
Sensor	The name of the sensor and an icon showing the sensor type:  Leica Disto control point  Water level  Leica Nivel 20/200 and other sensor control point  Humidity sensor control point  Temperature sensor control point  Combined temperature/pressure sensor control point  Pressure sensor control point

	 Rain gauge  Combined temperature/pressure/humidity sensor control point  Leica DNA and Sprinter Level control point  Campbell Scientific datalogger  Virtual sensor
Point	The name of the sensor control point.
Time	The date/time that the null measurement was last updated.
Observation Type	The observation type. Some sensors will have more than one observation type and will use more than one row in the dialog.
Current Value	The current reading from the sensor/observation type.
Null Value	The null value set for the sensor/observation type. **Important:** The default Null Value is set to zero.
Unit	The display units.
Description	Enter a description to record important information about the null value that has been entered.

Measure	Measures from the sensor and updates the Current Value.
Update Null	Sets the Null Value to match the Current Value.

Message Configurator

Background Information:

The messaging functionality is license protected. This functionality can be purchased with GeoMoS Monitor Option 2 (article number 774 136). Please contact your Leica representative.

The **Message Configurator** is used to dispatch system messages. For example you can send the message "long time limit exceeded" to different E-Mail addresses. It is also possible to run external applications or switch ON/OFF a relay on a digital input/output card. All of these different events are referred to as **Actions**. The following actions are available:

- run to external application (command line)
- send an email to a specified email address
- send an SMS to a specified telephone number
- switch ON/OFF a relay on a digital input output card
- run a database query and save the result to a file

To send email, you need to have access to an Internet or dial up connection and, in addition, a properly configured email account is required.

To open the Message Configurator:

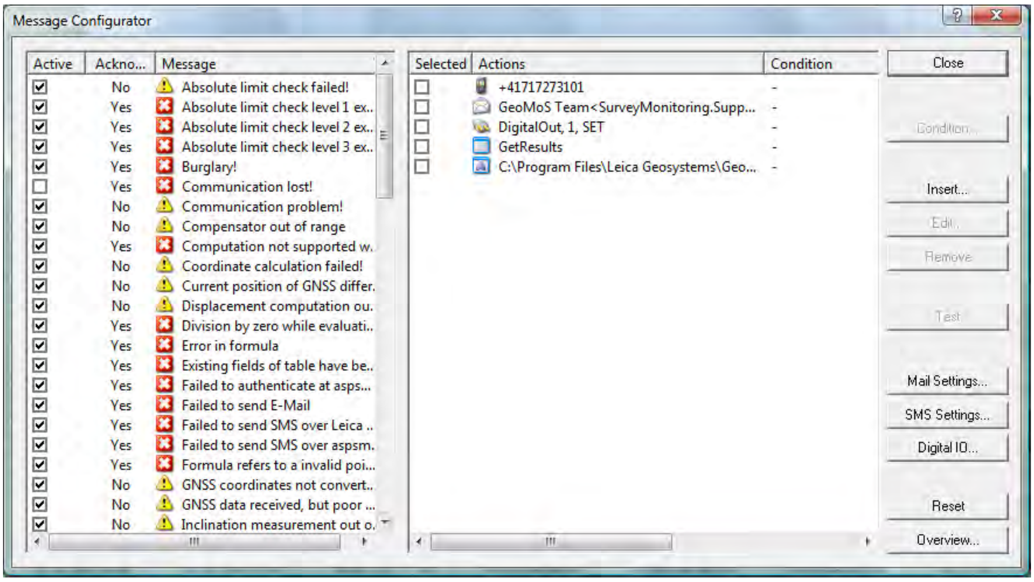
Follow these steps to open the Message Configurator.

Step	Action
1	Select the menu **Configuration**, **Message Configurator...** or click on the toolbar **Messages button** .
2	The **Message Configurator** dialog will be shown. In the list on the left-hand side of

	the dialog all Messages are listed which the GeoMoS Monitor can generate. On the right-hand side you see all Actions.
3	Use the **Add Action** button to configure an action. You will be required to enter specific information for the action based on its type (Application, E-Mail, SMS, Digital Out, Database Query).
4	If you wish, a condition may be set for the selected Action using the **Condition** button.
5	Select the messages that you wish to trigger the action in the Message window on the left and activate the check box for the action in the Action window. You can link multiple Actions to one Message.
6	Use the **Overview** button to get a summary of which actions are assigned to messages.
7	Change the settings as required.
8	Click the **Close** button. The **Message Configurator** dialog will be closed and the settings saved.

Note: The above description guided you through the creation process by describing the minimum settings only.

Read below or click on the Message Configurator image to learn about all properties in detail.



The table below describes the fields and buttons in the Message Configurator dialog box.

Field/Button	**Description**
Messages:	
Active	Check this box to activate the actions which are linked to the message. If the checkbox is disabled (not checked) GeoMoS Monitor will not run the actions if the message is generated from the system.
Acknowledge	Messages can be selected to be acknowledged or not. The Acknowledge column can be set to Yes or No by double clicking in the table on the cell. **Acknowledgeable Messages:** The user must manually or automatically acknowledge acknowledgeable messages when the column Acknowledge is set to **Yes** and the symbol  appears. **Not acknowledgeable Messages:** The column Acknowledge is set to **No** and the symbol  appears.
Message	All available system messages are listed in the column. The messages can be selected to be acknowledged or not. Acknowledgeable messages are displayed with a different icon to normal messages.

Actions:	
Selected	With this checkbox you can activate one ore more actions to a selected message. Select in the left-hand list a message (e.g. "power failure") and in the column Selected you check all actions you will activate for the message e.g. "power failure".
Actions	For define new actions in the right-hand list on this dialog you can use the functions Add Action....

Condition	List the configured condition.

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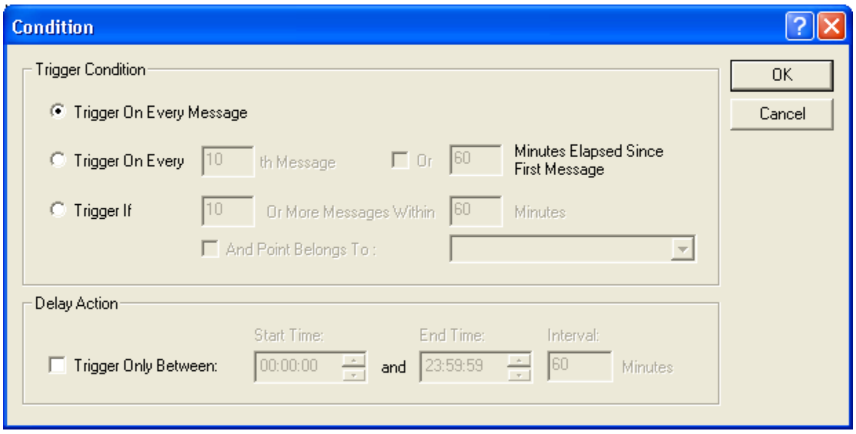
You can set conditions for the currently selected action using the Condition button. You will be presented with the following dialog.



Trigger On Every Message

Activate this radio button to execute an action without any delays. With the check box Trigger Only Between the action is hold back for a defined interval in a defined time range.

Trigger On Every

Activate this radio button to execute an action after a defined number of messages. In addition you can check the minutes elapsed since the first message was produced from the system. With the check box Trigger Only Between the action is hold back for a defined interval in a defined time range.

For more detailed information about this function see the Conditions Dialog Examples.

Trigger If

Activate this radio button to execute an action after a defined number of messages in a time range. In addition you can restrict this condition for a point group. With the check box Trigger Only Between the action is hold back for a defined interval in a defined range.

For more detailed information about this function see the Conditions Dialog
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Examples.
Trigger Only Between:
Each of the above defined trigger conditions can be enabled with this check box for a defined interval in a defined time range.
For more detailed information about this function see the Conditions Dialog Examples.
Important Notes:

Actions may be hold back with the conditions, but are never deleted from GeoMoS Monitor. You can display all messages in Message tab and retrieve them from the database.
Conditions take in account every message that is linked to an action, but conditions are not point related!
For messages to trigger and set conditions, it may be reasonable to define identical actions more than once in the Message Configurator. This helps that different messages can be triggered with different options to the same action e.g. an mobile phone.
If multiple limit checks of a measurement are exceeded simultaneously then only the highest limit level message will be displayed!
Sometimes the three limit checks are not used competently (e.g. only limit level 1 and 2 are used and limit level 3 not). Therefore define an very high and nearly impossible limit value to the unused limit level 3. This causes that system will produce an action that is defined to the lower limit levels and not to the unused limit level.
Using the Stop/Start button deletes the counter of the conditions, the so-called cache. If multiple messages belonging to a condition occurred, but the condition was not yet fulfilled then the counter of the condition is deleted.

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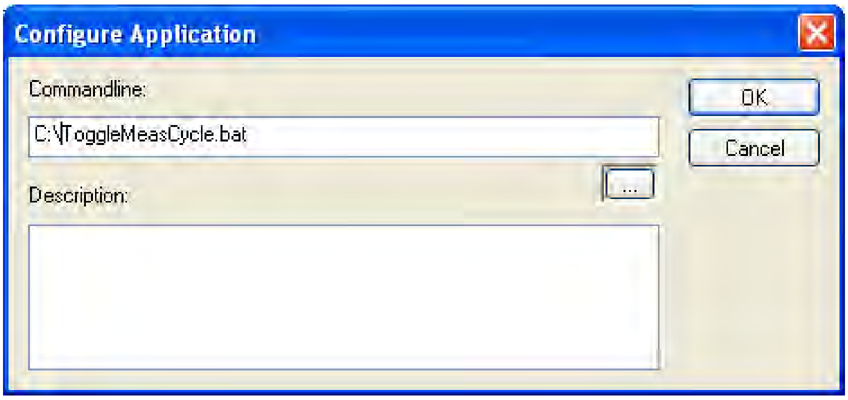
(New action)</td>
<td>Press the button and a sub-menu appears where you can select the type of the new action. You can choose between application, E-Mail, SMS, digital out and database query.</td>
</tr>
</table>

Application

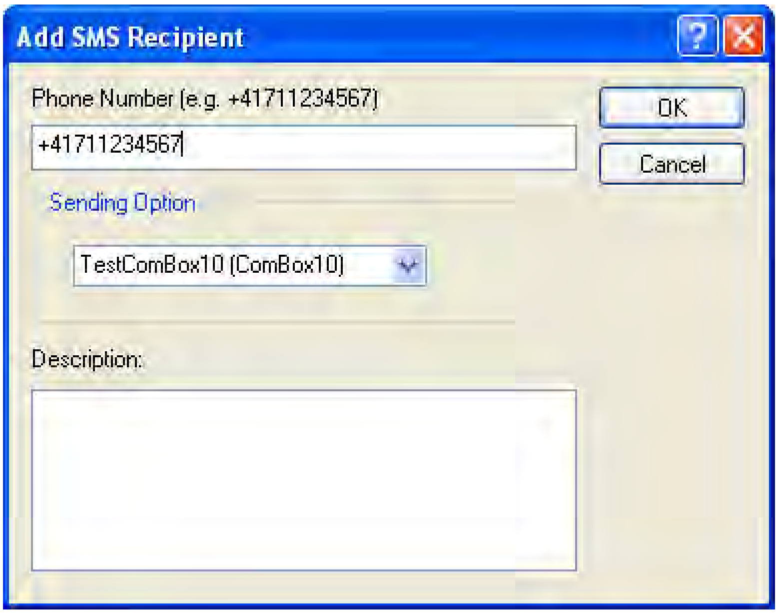


Define in the field command line an external application (EXE or BAT) which GeoMoS Monitor will run as an action. Always use the full path to the directory. The field Description is only a remark and has no additional functionality so it works also if this field is empty. Press OK and the new action is in the right list of the Message Configurator.
Example: An application reads some data by SQL out of the GeoMoS Database and stores this data in a ASCII file on the hard disk.

E-Mail

Define the name and E-Mail address of a recipient. In the next field you define the E-Mail subject. If for example the message "power failure" is generated from GeoMoS so this person will receive a E-Mail with this information. Press OK and the new action is in the right list of the Message Configurator.

SMS

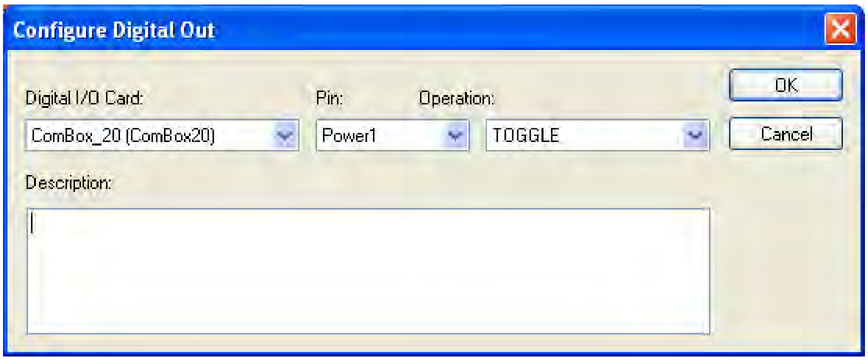


Define in the field Phone number the phone number of a recipient. Always use the country code. Then select in the list box your appropriate sending option. Following sending option are available: Leica GFU, ASPSMS.com and ComBox10/20. The field Description is only a remark and has no additional functionality so it works also if this field is empty. Press OK and the new action is in the right list of the Message Configurator.

Notes:

- The default length of a SMS is limited to 160 characters (e.g. the Leica GFU can only send SMS with 160 characters)
- The default length of a SMS can be changed in the Windows Registry for the ASPSMS.com service:
  [HKEY_LOCAL_MACHINE\SOFTWARE\Leica Geosystems\Leica GeoMoS\Projects\<project_name>\EventManager]
  "SmsMaxSize"="160"
- Sending SMS over a ComBox10/20 is only available when a MonBox is integrated in the ComBox and the ComBox is configured in the right manner.

Digital Out



This function works only if you have installed an **ICP DAS I/O Card** in your PC, a **W&T Digital Web I/O** device is connectable via an IP address or a **ComBox10/20** is configured within your GeoMoS project. If GeoMoS Monitor generates an event, this action will switch ON/OFF the digital output channel. For example, it is possible to switch on a flashing light.

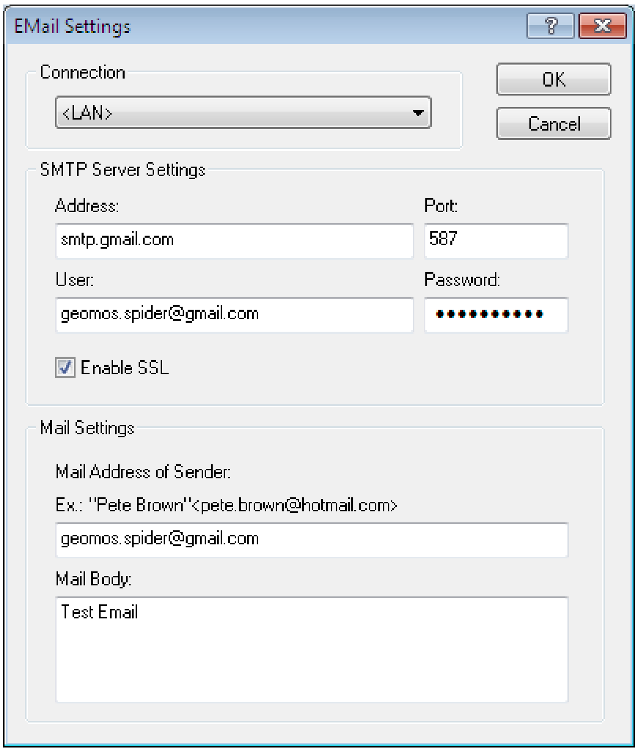
In the list box Digital I/O Card you select your configured digital I/O card. In the field Pin you define the number of the channel or the port in case of a ComBox10/20. Typically a digital card has 8 or 16 output channels. In the field Operation there is a listbox with the entries **SET**, **RESET**, **TOGGLE** and **RECYCLE POWER**. With SET you switch on a digital output (Example: light on). With RESET you switch off the channel (Example: light off). If you choose the item TOGGLE, this case will first switch on and by the next event it will switch off. With RECYCLE POWER you switch off and on a digital output within two seconds (Example: switch off and on a total station within two seconds, like a switch box it does).

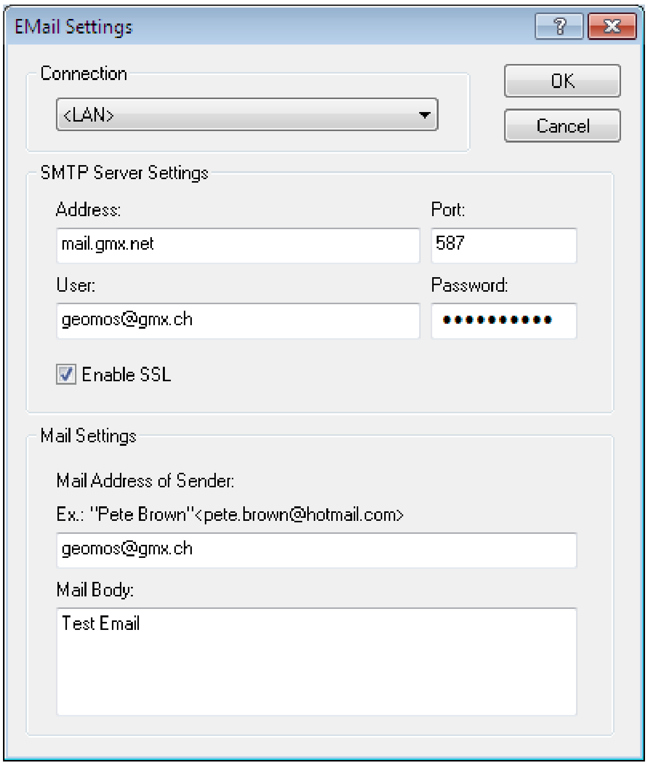
With GeoMoS Monitor it is also possible to control a digital input (Example: burglary). But for this definitions you need the Windows Registry Editor. Press OK and the new action is in the right list of the Message Configurator.

Note: The operation in the list box Operation for a COM port of a ComBox10/20 is always set to RECYCLE POWER.

Database Query

	 Define in the field Query Identifier a Name for the database query. Enter in the field Query the SQL statement. Define in the field Output the path for the output file. Always use the full path to the directory. Retrieved data will always be added at the end of the file. Press OK and the new action is in the right list of the Message Configurator.
	Please select an action first in the list. Press the button **Edit** and then it is possible the edit the selected action.
	Press this button to delete a selected action.
	Press this button to immediately test a selected action. This function can be used for control all actions.
	This function defines the parameters for sending E-Mails. E-Mails can be sent over LAN or Dial-Up Network. Press the button and the E-Mail settings dialog will be shown.





Dial Up Connection

Select a valid Dial-up Connection from the drop down list. The drop down list contains a list of all current Dial-up Connections configured on the computer.

Select an appropriate Dial-up connection for sending E-mails.

SMTP Server Settings

Field/Button	Description
Address	Enter a valid SMTP Server name in the field. The SMTP Server name is usually supplied by the E-mail Provider (e.g. smtp.gmail..com, mail.gmx.net, mail.hotmail.com).
Port	The SMTP Server port is usually supplied by the E-mail Provider (e.g. 25, 465, 587).
User	User name of the registered E-mail account. The user name maybe the E-mail address or an ID.
Password	Password of the registered E-mail account.
Enable SSL	Enable or disable the SSL checkbox according to the E-mail Provider requirements.

Mail Settings

Field/Button	Description
Mail Address of Sender	Enter a valid E-mail address in the field, from where the messages will be sent. This is normally the E-mail address of the account from the E-mail Provider (e.g. name@gmail.com, name@gmx.ch, name@hotmail.com). E-mail addresses must have the following format: name@location.domain
Mail Body	Enter the text body that will be sent with the E-mail. The E-mail subject heading will appear as message text and the name of the Monitoring System.

Notes:

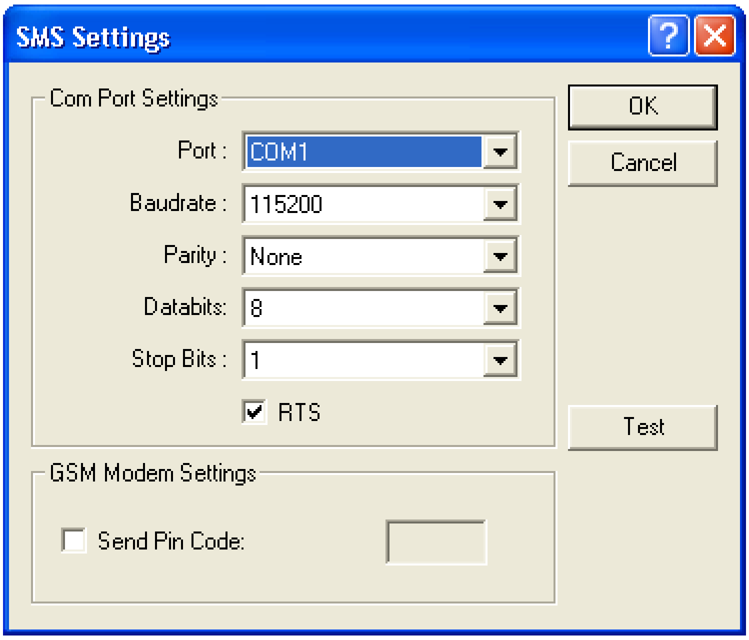
- If the computer is connected to a network with access to the Internet, the Dial-up connection need not be started. The Message Configurator will always try to send the E-mail via the network connection to the Internet.

Select the SMS Settings, either Leica GFU or ASPSMS.com.

Important:

Leica GeoMoS can not guarantee that a SMS will be received, because this function is affected by the operational availability of the mobile network provider.

Leica GFU



Field/Button	Description
Com Port Settings	
Port:	The serial port that the GMS phone is connected to.
Baud Rate:	The baud rate used by the GSM phone.
Parity:	The parity used by the GSM phone.
Data bits:	The data bits used by the GSM phone.
Stop Bits:	The stop bits used by the GSM phone.
RTS:	Request to Send. **Important**: For Leica GFU mobile phones activate the RTS setting.

GSM Modem Settings	
Send PIN Code:	Set this option to send a PIN to the phone.
PIN Code:	The PIN (Personal Identification Number) used to enable access to the phone.

Test	Use this button to test the communication between GeoMoS and the GSM phone.

ASPSMS.com

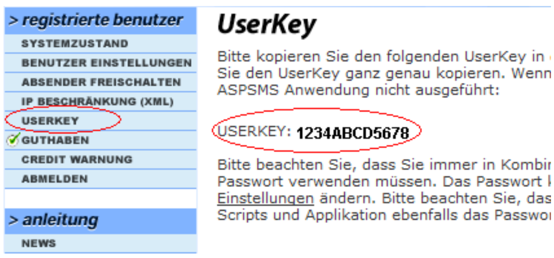
With ASPSMS it is possible to send SMS over Internet. For more details see ASPSMS.com.

Important: It is possible to use ASPSMS within a firewall. The port on the client side (GeoMoS PC) sends the SMS over Internet through **port 5061**.

Field	**Description**

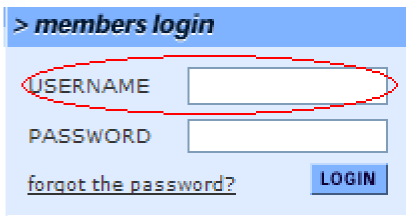
<table>
<tr><td></td><td>
<table>
<tr><td>Provider Settings</td><td></td></tr>
<tr><td>User Key:</td><td>
The registered user key for the ASPSMS account.
How to check the User Key:

Login to www.aspsms.com
Select in the left menu the entry USERKEY

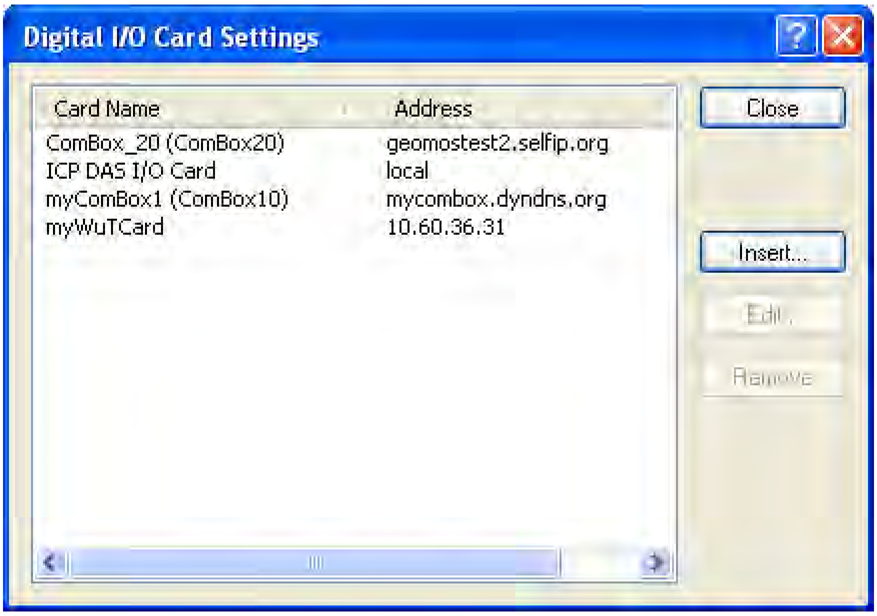


</td></tr>
<tr><td>Password:</td><td>
The valid password for the ASPSMS account.
How to check the password:

The password is identical to your www.aspsms.com account



</td></tr>
</table>
</td></tr>
<tr><td>
</td><td>This button displays the dialog with the inserted Digital I/O Cards and their settings.</td></tr>
</table>



Three types of Digital I/O Cards can be displayed:

- **W&T Digital I/O Card**
- **ICP DAS I/O Card**
- **Digital I/O Card from a ComBox10/20**

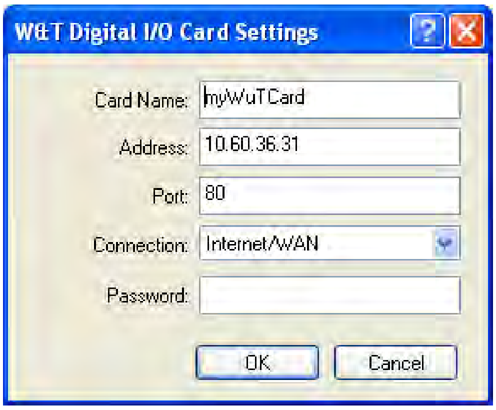
Field/Button	Description
Card name:	Name of the Digital I/O card: ▪ Name of a W&T Digital I/O Card can be defined ▪ Name of a ICP DAS I/O Card is not changeable ▪ Name of a Digital I/O Card from a ComBox10/20 is given by the name of the ComBox10/20. Behind the name in brackets the type of the ComBox is written.
Address:	The address that the digital card is connected to: ▪ W&T Digital I/O Card: IP address ▪ ICP DAS I/O Card: this card is

	connected locally to GeoMoS ▪ Digital I/O Card from a ComBox10/20: DynDNS name (host name of the ComBox10/20)
Close	Close the dialog
Insert...	Insert a new Digital I/O card: ▪ W&T Digital I/O Card: It is possible to insert multiple cards and define their communication parameters. ▪ ICP DAS I/O Card: Only one local card can be inserted. ▪ The Digital I/O Card from a ComBox10/20 is inserted automatically when you configure a ComBox with the ComBox Manager of GeoMoS Monitor.
Edit...	Edit an inserted W&T Digital I/O card
Remove	Remove an inserted W&T Digital I/O Card or ICP DAS I/O Card. A Digital I/O Card from a ComBox10/20 cannot be removed in this dialog.

Digital I/O Cards Properties:

Digital I/O Cards	**Properties**
ICP DAS Digital I/O Card	No additional settings are required.
	Before you begin: 1. The ICP DAS Digital I/O Card is delivered with a CD. 2. Install the **driver.exe** from the CD.

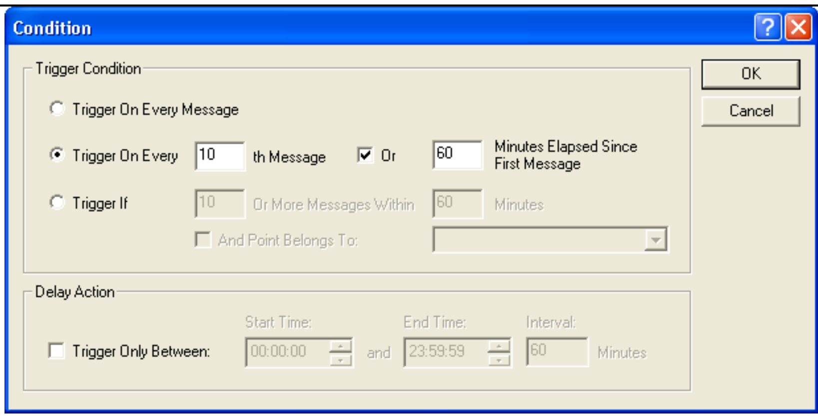
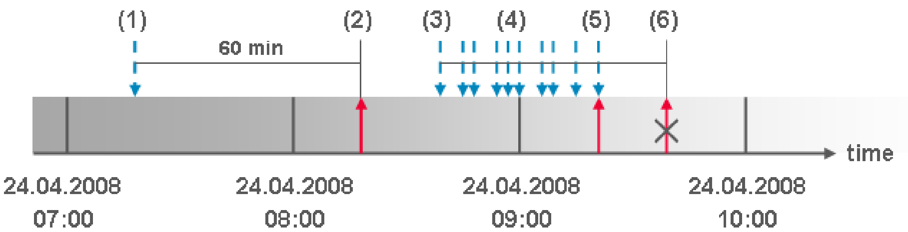
	3. Start the test program **Diag.exe.** 4. Select in the test program **Activate** and test the relay of the ICP DAS Digital I/O Card. Typically the relay clicks if you trigger it.

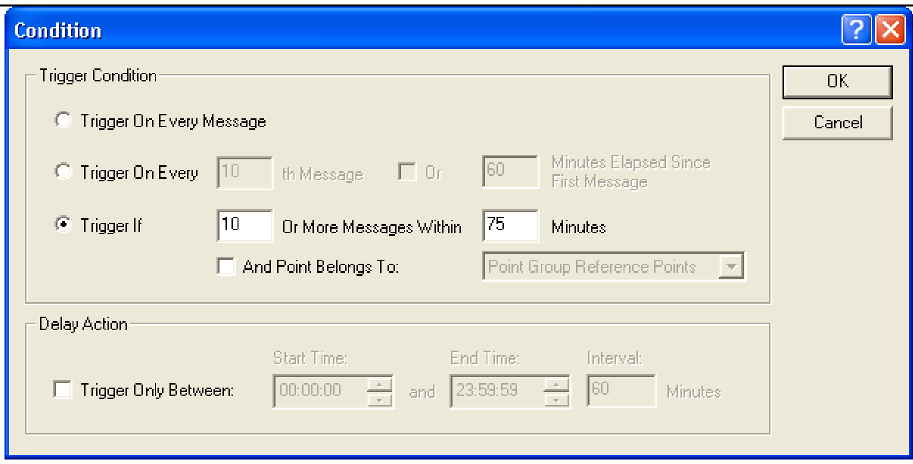
W&T Digital I/O Card	
Card Name:	Name of a W&T Digital I/O Card
Address:	The IP address that the digital card is connected to.
Port:	The port used by the digital card.
Connection:	The used connection type (LAN or cable, WLAN, radio link, Internet, mobile link). This connection uses pre-defined communication time out settings that apply best for the used connection type.
Password:	Enter a password if it is required.

Digital I/O Card from a	No additional settings are required.

	ComBox10/20
	All the links between messages and actions will be deleted.
	Displays a list of all configured actions.

Conditions Dialog Examples

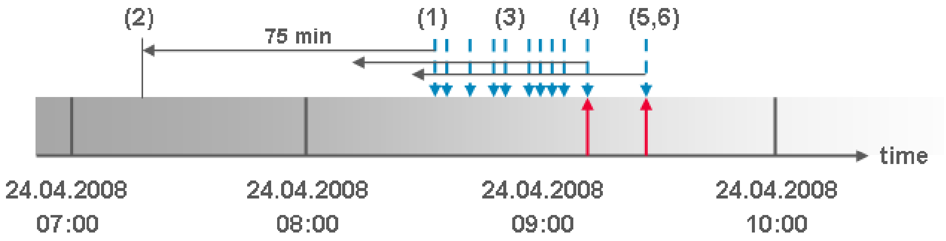
Example 1	
Settings	
What happens	▪ The first **Message** (1) that is generated in GeoMoS Monitor starts an internal timer. ▪ After 60 minutes GeoMoS Monitor dispatches the configured **Action** (2). The internal timer is stopped. ▪ The next **Message** (3) that is generated starts again an internal timer. ▪ In this case additional **Messages** (4) are generated before the 60 minutes are elapsed. GeoMoS Monitor dispatches the configured **Action** (5) when the 10th Message is generated. The internal timer is stopped. ▪ 60 minutes after the Message (3) was generated, nothing happens (6). 

<table>
<tr><td>Example 2</td><td></td></tr>
<tr><td>Settings</td><td>


</td></tr>
<tr><td>What happens</td><td>

The first Message (1) that is generated in GeoMoS Monitor checks the previous 75 minutes (2) for other messages.
GeoMoS Monitor does not dispatch the configured Action if there are no other messages in the previous 75 minutes.
In this case additional Messages (3) are generated after the first Message (1). GeoMoS Monitor checks for every Message the previous 75 minutes. GeoMoS Monitor dispatches the configured Action (4) when the 10th Message within 75 minutes is generated.
For E-Mails only: GeoMoS Monitor dispatches an E-Mail including all ten Message texts.
For SMS only: GeoMoS Monitor dispatches an SMS with the Message that generated the Action (4).
The next Message (5) that is generated in GeoMoS Monitor checks again for Messages in the previous 75 minutes. Here GeoMoS Monitor dispatches the configured Action (6) because there are still 10 messages in the previous 75 minutes available.
For E-Mails only: GeoMoS Monitor dispatches an E-Mail including only the last Message (5) text. The previous Message texts are already sent before and deleted from the E-Mail queue.
For SMS only: GeoMoS Monitor dispatches an SMS with the last Message (5) that generated the Action (6).

</td></tr>
</table>

	(2) 75 min (1) (3) (4) (5,6) time 24.04.2008 07:00 24.04.2008 08:00 24.04.2008 09:00 24.04.2008 10:00

Compute Daily Average

Background information

The daily average is the average position of each point for each calendar day. The daily average is used for analysis of long term tends and may be displayed in the **Analyzer**.

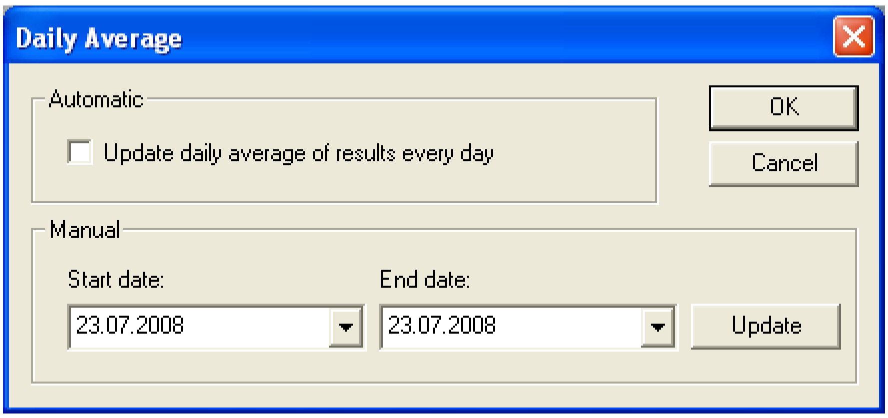
Note:

- The Daily Average only calculates the average of the results.
- Results that are de-activated in the GeoMoS Analyzer, Report tab are excluded in the calculation of the Daily Average. A manual re-processing may be required.

To open the Daily Average

Follow these steps to open the Daily Average.

Step	Action
1	Select the menu **Configuration**, **Daily Average...** .
2	The Daily Average dialog window is displayed.



The table below describes the fields in the Daily average dialog box.

Field	Description
Automatic	If this option is selected then the daily average will be calculated automatically. The daily average may be displayed in Analyzer.

Manual	These settings may be used to manually calculate the daily average for a given time period.
Start Date	The start date for the manual daily average calculation.
End Date	The end date for the manual daily average calculation.

Update	Press this button to calculate the daily average for all points between the start and end date entered above.

Auto Export Settings

Background information

The export of data can be done from GeoMoS Monitor. The data can be exported automatically. For the automatic export the **SQL Server Agent** has to be started.

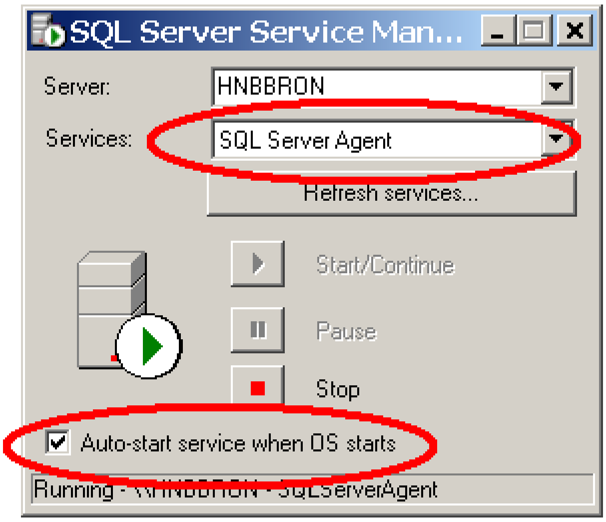
Important:

The export is not available for external devices. The used SQL command not supports the access to any external device.

To open the Auto Export Settings dialog

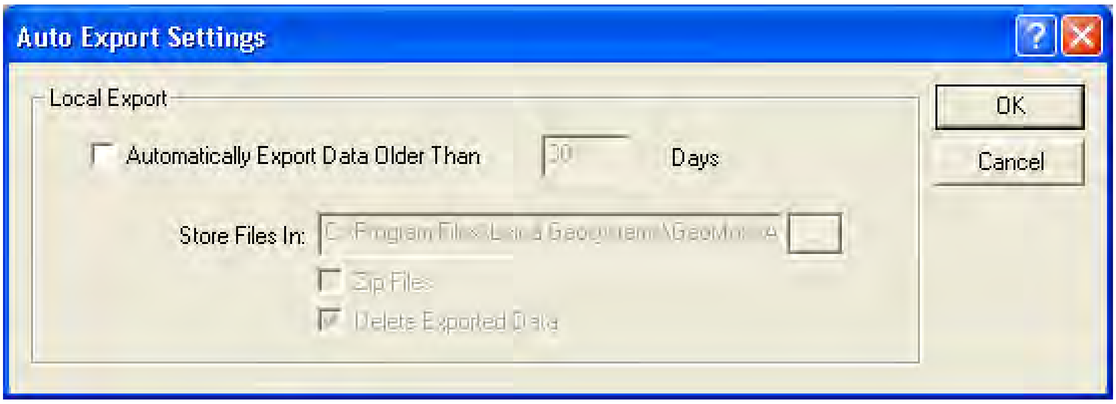
Important (MSDE only):

For the automatic export the **SQL Server Agent** has to be started.



Follow these steps to open the Auto Export Settings dialog.

Step	Action
1	From the **File** menu select **Configuration**, **Auto Export Settings...**.
2	The **Auto Export Settings** dialog will be displayed.

	
3	Select a time range in days. All data older than the selected range will be exported. If you select 30 days data older than 30 days will be every 30 days exported.
4	Enter a **path** where the data should be stored. **Hint:** Export files will be created with the file naming convention: GeoMoS Export Date Time.dat. Example 'GeoMoS Export 19-October-2001 16-30-02.dat'. The files can be re-imported to the monitoring system.
5	Check the check box **Zip Files** to compress the exported data.
6	If the check box **Delete Exported Data** to activate the **data** will be **deleted** after the automatic export is executed successfully.
7	Click the **OK** button to exit this dialog. If this dialog is closed the first time with an active auto export, the upcoming next hour an export will be done. All following exports are done at midnight.

Options

Background information

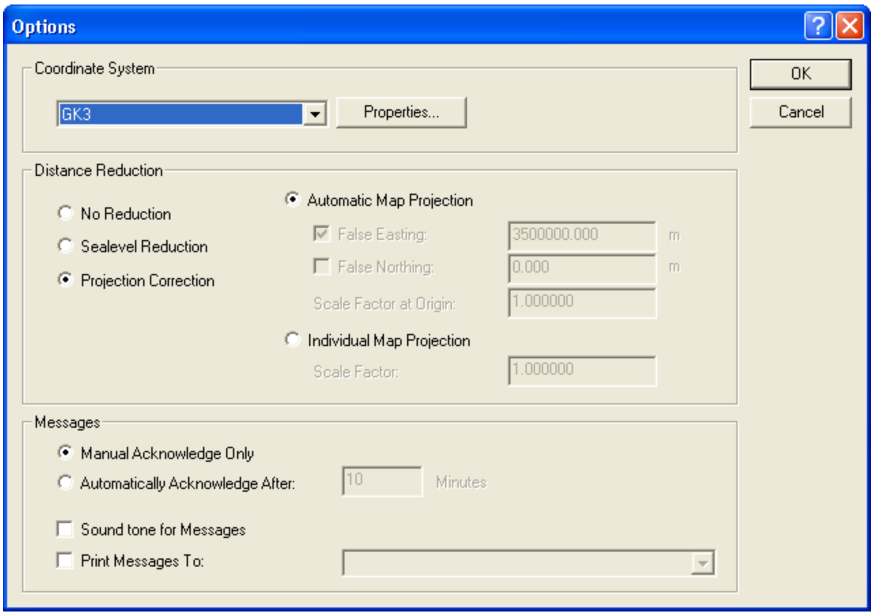
The Options contain various settings for the Measurement Cycle, Computations, Test Conditions and database. The settings are valid for all points, and respectively for the whole system.

To open the Options dialog

Follow these steps to open the Options.

Step	Action
1	Select the menu **Configuration**, **Options...** or click the toolbar **Options button** .
2	The **Options** dialog window opens.
3	Change the settings as required.
4	Confirm the changes with the **OK** button.

Read below or click on the Options Image to learn about all settings in detail.



The table below describes the fields and buttons in the Options dialog box.

Field/Button	Description
Coordinate System	The coordinate system is applied to: ▪ GNSS data and ▪ Total Station measurements (excluding the distance reduction). The distances reduction is applied with the separate setting Distance Reduction. A coordinate system provides the information necessary to convert coordinates to different representations (Cartesian, Geodetic, Grid) and to transform coordinates between the WGS1984 and the local system. A coordinate system consists of five elements: ▪ Transformation ▪ Projection ▪ Ellipsoid ▪ Geoid Model ▪ Country Specific Coordinate System (CSCS) Model
List Box	The selected coordinate system.
Properties...	Opens the Coordinate System Manager to define a new coordinate system for further use in a project. Transformations, ellipsoids, projections, geoid models and CSCS models must be previously defined in order to be able to select them from the lists. **Warning:** ▪ A coordinate system is used to convert GNSS coordinates from WGS84 to the coordinates system used in the monitoring project. ▪ The default coordinate system WGS84 can be used if no GNSS sensors are connected. If one or more GNSS sensors are connected a coordinate system must be defined or GeoMoS will not be able to use the data from the GNSS sensors. ▪ Changing the coordinate system will cause subsequent results from GNSS sensors to produce different coordinates. This may result in a sudden jump in the coordinates.

	Related topics Tour VIII: Configure a coordinate system Examples of coordinate systems

Distance Reduction	**Information:** ▪ The atmospheric reductions are configured with the meteo model.
No Reduction	The measured distances are reduced with the refraction (curvature of the path of the beam) and the chord-to-arc correction. The measured distances are not corrected to sea level and for the projection. **Database** (Global distance reduction setting): 0
Sealevel Reduction	The measured distances are reduced with the refraction (curvature of the path of the beam) and the chord-to-arc correction and are corrected to sea level. The measured distances are not corrected for the projection. **Database** (Global distance reduction setting): 1
Projection Correction	The measured distances are reduced with the refraction (curvature of the path of the beam) and the chord-to-arc correction, are corrected to sea level and projection. Two methods can be used to apply the projection correction: ▪ Automatic Map Projection (only for cylindrical projections) ▪ Individual Map Projection (for all projection types) <table><tr><td>Automatic Map Projection</td><td>**Only for cylindrical projections** The calculation is based on the offset from the line of projection (central meridian) and the</td></tr></table>

	projection scale factor at the central meridian (for example Gauss-Krüger = 1.0, UTM = 0.9996, etc.)) **Notes**: ▪ The fields False Easting, False Northing and the Scale Factor at Origin are not editable in this dialog. This information is read from the projection properties of each projection. ▪ The projection correction for measured distances will be calculated if the appropriate False Easting or False Northing is not set to 0. If you like to set the appropriate False Easting or False Northing to 0 then put a value close to 0 (e.g. 0.0001) in the field.
Individual Map Projection	**For all projection types** Enter the projection scale factor directly. **Note**: This setting is a factor and is unit less. If you have a ppm value then you have to first convert this value into a factor. The formula is: Scale Factor = 1 + ppm/1000000

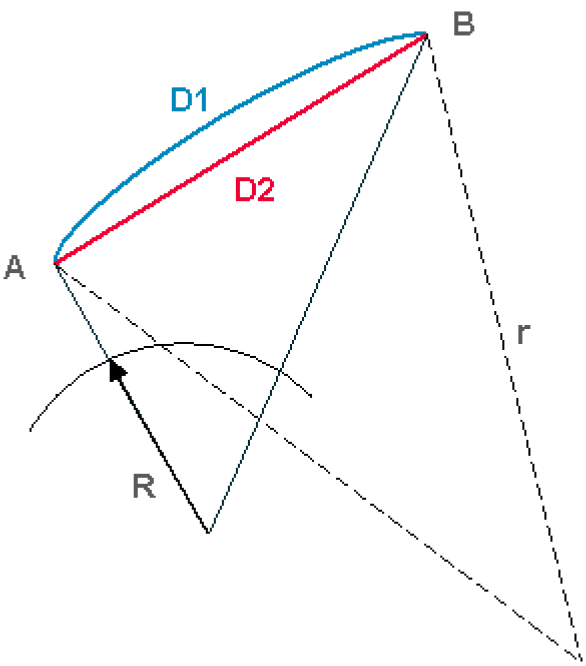
Database (Global distance reduction setting): 2

Messages	
Manual Acknowledge	Messages will only be acknowledged by the operator.

Only ✔	
Automatically Acknowledge After ✔	Messages will be automatically acknowledged by the system after the specified time. **Note:** GeoMoS Monitor will check every minute for messages that need to be automatically acknowledged.
Sound tone for Messages	If activated GeoMoS will make a sound whenever a message is created by the system.
Print Messages To	If activated, select the printer that will be used to print the messages from the system.

Background information for the reduction of distances

Curvature of the path of the beam



Light waves are not propagated in a straight line between two points. Due to refraction they have a curved path. As a result, the length of the arc D1 has to be reduced to that of the chord D2.

The effect of the curvature of path needs to be taken in account over large distances (exceeding 50 km).

A = Point A

B = Point B

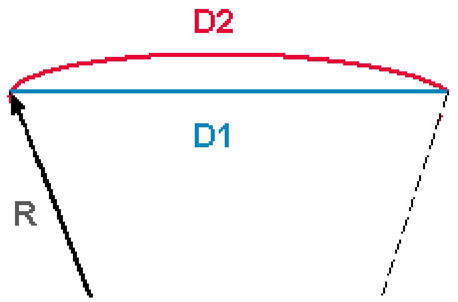
R = Radius of the Earth

r = Path radius

D1 = Arc

D2 = Spatial chord

Chord-to-arc correction



Since the surface of the earth is curved, the chord D1 has to be converted to the arc D2.

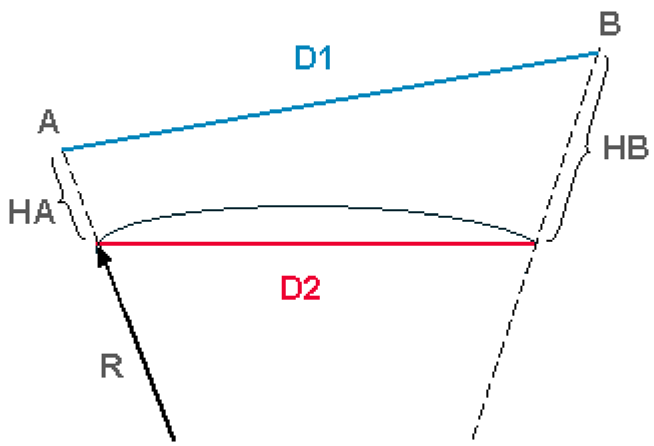
The chord-to-arc correction need to be taken into account only when distances are greater than 10 km.

R = Radius of the Earth

D1 = Chord

D2 = Arc

Reduction to sea level



Reduction of the spatial chord D1 to a chord at sea level D2 can be carried out either with using heights or using the vertical angle. GeoMoS uses the directly reduction to sea level with known heights.

A = Point A

B = Point B

HA = height of A

HB = height of B

R = Radius of the Earth

D1 = Spatial chord

D2 = Chord at sea level

Customize

Background information

This dialog contains the different settings for time format, point obstruction, status messages, units and coordinate system.

To open the Customize dialog

Follow these steps to open the Customize dialog.

Step	Action
1	Select the menu **Configuration**, **Customize...** or click the toolbar **Customize button** .
2	The **Customize** dialog is shown.
3	Change the settings as required.
4	Confirm the changes with the **OK** button. The changed settings will be applied and used in the application.

The table below describes the fields and buttons in the Customize dialog box.

Field/Button	Description
General	
Time format	Select the preferred time format from the list. The time format is used for the display of all time values in the application. In addition, the splash screen that is displayed when the application is started can be turned on or off. If the option is checked, the splash screen will be displayed when the application is started.

Splash Window	
Display Start Window	Activate / Deactivates the start window.

Units	The following units can be selected:

Available system units	Internal unit	All supported units
Distance	m	Meter [m], US Survey feet [fts], International feet [fti]
Angle	rad	Degree [dec], DMS [dms], Decimal DMS [dms], Grad [grad], Gon [gon], Decimal Gon [gon]
Inclinations	rad	Radians [rad], mRad, mm/m, Decimal Gon [gon]
Temperature	°C	Celsius [°C], Fahrenheit, Kelvin
Pressure	mBar	mBar, Pascal, PSI, Torr

In addition the number of decimal places displayed for values can also be defined.

Panes	
Display	The length of the history to be shown in the Last Actions, Observations and

Period for panes	Messages tabs in days. (Maximum number of days = 1000)
Max. row for panes	The maximum number of rows to be displayed in the Last Actions, Observations and Messages tabs. (Maximum number of rows = 500000)

Fonts Overview Pane	
Headers	Use this button to set the font and style to be used for the table headings.
Text	Use this button to set the font and style to be used for the table content.

Animations	Select the Animated GIF to be displayed on the overview tab for each system state.

Overview Picture	
Image	Select the picture (Bitmap or JPEG) to display on the overview tab or use the default.
Display image from webcam if available	Check or un-check to display webcam image.

Services

Webcams

Background Information

Webcam images show at a glace the situation on site. Images collected over time can be used for and aid site analysis.

Webcam requirements

Various webcam manufacturers are on the market with many different hardware and software options. It is important to note that Leica GeoMoS only supports IP cam models with the following features

- IP address (dynamic or static) or
- an unique path to the latest webcam image. For example: http://your_camera_address/current_image.jpg
- jpg, jpeg or png format

Important:

- Webcams that are connected via USB are not supported.
- Webcams that require a login with user ID and password are not supported.
- When you connect a webcam powered over Ethernet (PoE) to the ComBox20 via a LAN port of the unmanaged Ethernet switch, the IP address of the webcam must be between **192.168.1.30 and 192.168.1.32**. Otherwise you are not able to communicate with the webcam over mobile Internet.

Configure a Webcam

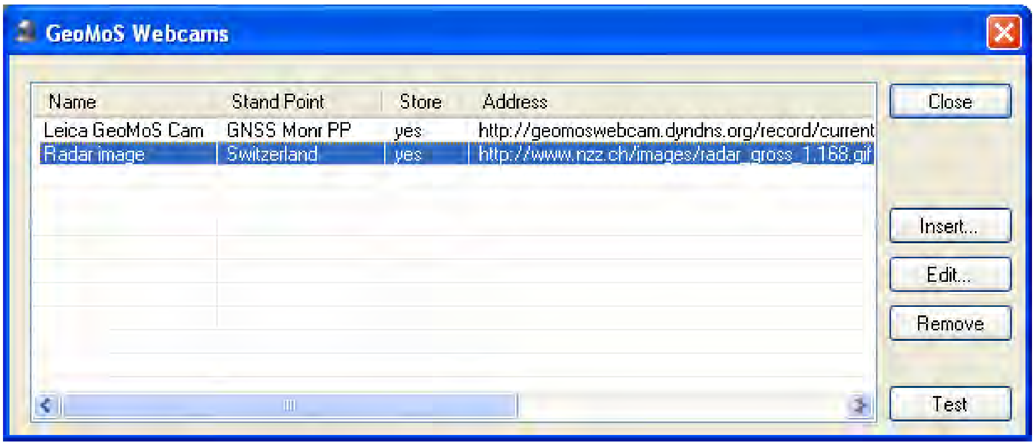
Follow these steps to configure a Webcam.

Step	Action
1	Select the menu **Services**, **Webcams...**.
2	The **Webcams** dialog will be displayed. When opening this dialog for the first time all fields will be empty.
3	Press **Insert...**. The **Webcam - Insert Camera** dialog box will open.

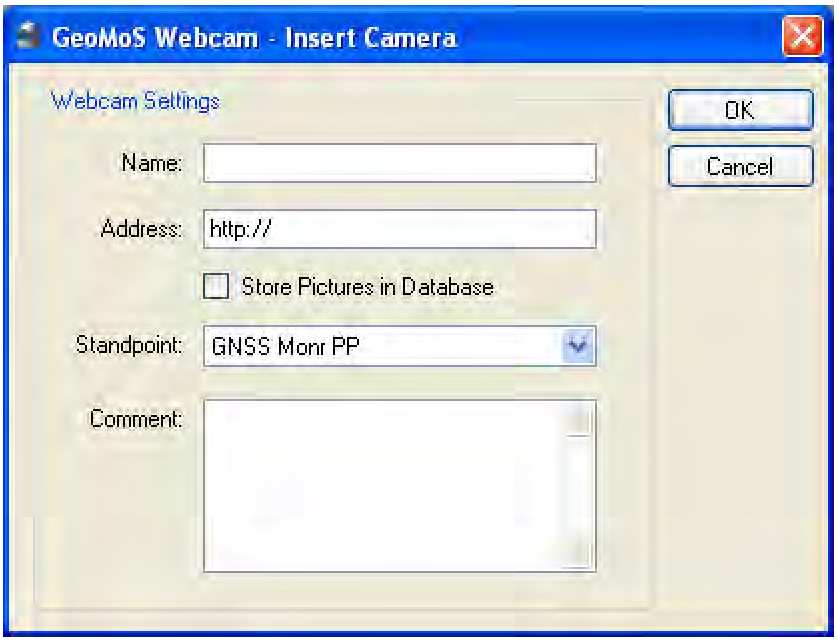
4	Enter the webcam settings. ▪ Enter the webcam name. ▪ Enter the address of the webcam. ▪ Che ck **Store pictures in Database** to push webcam images to Leica GeoMoS Web. ▪ Stand point: Select the sensor location. ▪ Enter a comment or a possible description about the webcam. Press **OK** to save the settings and close the dialog.
5	The webcams settings will be visible. Each row shows one configured webcam. Press **Close** to save the settings and close the dialog.
6	The **Store pictures in Database** checkbox determines what can be done with the webcam image/s. ▪ If you left the box un-checked the webcam image will only be visible in the **Overview** tab, once measuring is activated. The check box Display image from webcam if available must be checked in the menu **Customize**. ▪ When checked you are able to push the webcam images to Leica GeoMoS Web. Please read the topic Data Push to GeoMoS Web for further information.
7	Select the menu Configuration, **Measurement Cycle Editor...**.
8	The **Measurement Cycle Editor** dialog will be displayed. Press **Insert...**. A new line appears and the webcam can be added as **Action** to the measurement schedule.

Note: The above description guided you through the creation process by describing the minimum settings only. Please read the remainder of this topic for more detailed information.

Webcam Settings



Field/Button	Description
Name	The name of the webcam.
Stand Point	The sensor location of the webcam.
Store	Indicates via Yes or No if the webcam images are stored in a database.
Address	The address of the webcam.

	Press **Insert** to configure a webcam. The **Webcam - Insert Camera** dialog box will open. 

Field	Action
Name	Enter the name of the webcam.
Address	Enter the address of the webcam.
Store pictures in Database	Check or un-check to store the webcam pictures in a database. ▪ If you want to store the webcam images to the SQL database you must check this box. The webcam images can be accessed via SQL statements. ▪ If you want to push the webcam image to Leica GeoMoS Web you must check this box. Please read the topic Data Push to GeoMoS Web for further information. ▪ If the box is left unchecked, the single webcam image can be viewed in the **Overview** tab, once measuring is activated. The check box Display image from webcam if available must be checked. Open the Measurement Cycle Editor and find the action for your webcam image. The Interval field will determine how regularly the webcam image is updated. **Notes:** ▪ The database size can grow considerably when storing

<table>
<tr><td></td><td>
<table>
<tr><td></td><td>webcam images.
Webcam images can be deleted with Tools - Shrink Database older than the specified age.</td></tr>
<tr><td>Stand point</td><td>Enter the sensor location.</td></tr>
<tr><td>Comment</td><td>Enter a comment or a possible description about the webcam. For example, the location of the webcam or its product details.</td></tr>
</table>
</td></tr>
<tr><td>Edit...</td><td>Select a webcam and press Edit to change its settings.</td></tr>
<tr><td>Remove</td><td>Select a webcam and press Remove to delete it.</td></tr>
<tr><td>Test</td><td>Press Test to test the webcam settings. When the test is successful, a new window will open showing the webcam image.</td></tr>
</table>

Data Push to GeoMoS Web

Background Information

In order to view your monitoring project GeoMoS Web you must configure a data push to GeoMoS Web.

The **Data push to GeoMoS Web** service pushes via FTP the monitoring and configuration data from the GeoMoS database to the Leica GeoMoS Web server. The monitoring data then can be accessed anytime, anywhere using a standard web browser.

All settings and configuration can only be edited whilst measuring is stopped. Once measuring is activated the monitoring and updated configuration data will be pushed to GeoMoS Web.

Before you begin

The **Data push to GeoMoS Web** service requires outbound TCP/IP ports.

- For monitoring data access with GeoMoS Web via internet

Port	Description	Direction
443	GeoMoS Web (https)	outbound

- For transferring monitoring data from the field to the GeoMoS Web server

Port	Description	Direction
21	GeoMoS Web (ftp)	outbound
80	GeoMoS Web Services end point	outbound
443	GeoMoS Web (https)	outbound
30000...31000	GeoMoS Web (ftp passive mode)	outbound

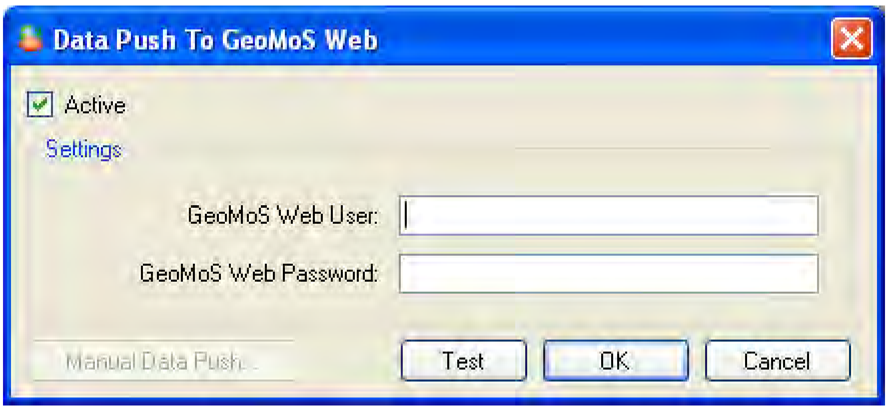
Configure a Data push to GeoMoS Web

Follow these steps to configure a data push to GeoMoS Web.

Step	Action
1	Select the menu **Services**, **Data push to GeoMoS Web...**.
2	Check the Active box.
3	Enter the GeoMoS Web **Administrator ID** and GeoMoS Web **Administrator Password**.
4	Test the data push or press **OK** to save the settings and close the dialog.
5	Select the menu Configuration, **Measurement Cycle Editor...**.
6	The **Measurement Cycle Editor** dialog will be displayed. Press **Insert...**. A new line appears and the **Data Push to GeoMoS Web** service can be added as Action to the measurement schedule.

Note: The above description guided you through the creation process by describing the minimum settings only. Please read the remainder of this topic for more detailed information.

Data push to GeoMoS Web Settings



Field/Button	**Description**
Active	Check to activate the Data push to GeoMoS Web settings.

Settings	
GeoMoS Web Administrator ID	Enter the administrator ID configured in GeoMoS Web.
GeoMoS Web Administrator Password	Enter the administrator password configured in GeoMoS Web.
	Note: If the administrator ID and administrator password changed in GeoMoS Web, it is required to adapt these settings in GeoMoS Monitor. The data push to GeoMoS Web cannot push data with different administrator ID's and passwords.

Manual Data Push...	Press to manually push data to GeoMoS Web. This button is only activated when the GeoMoS Web User and Password information is entered correctly. **Note**: The manual data push is done during the automatic measurement mode. This means that the measurement cycle needs to be started. The selected data is then pushed in packages. The time required to complete the manual data push is dependent on the amount of data and the push interval.
Test	Press to test the data push.
OK	Press **OK** to save the settings and close the dialog.
Cancel	Press to cancel and close the Data push to GeoMoS Web dialog.

Export Service to GeoMoS Adjustment

The export functionality is license protected. This functionality can be purchased with GeoMoS Monitor Option 3 (article number 774 137). Please contact your Leica representative.

In order to compute automatic network adjustment and deformation analysis results, .XML files for the Leica GeoMoS Adjustment software need to be configured.

Background information

Every geodetic observation is a random or stochastic value. Extra measurements are called redundancy data.

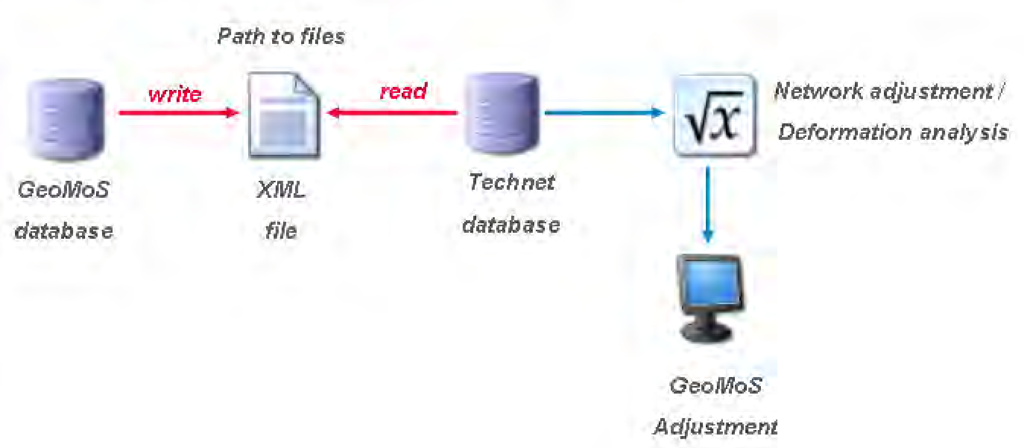
Network adjustment

Network adjustment describes observations with a mathematical and a stochastic model. The adjusted parameters are more precise and receive a statement of reliability.

Deformation analysis

Deformation analysis compares the results of the adjusted parameters epoch by epoch. The variation in the network geometry is considered.

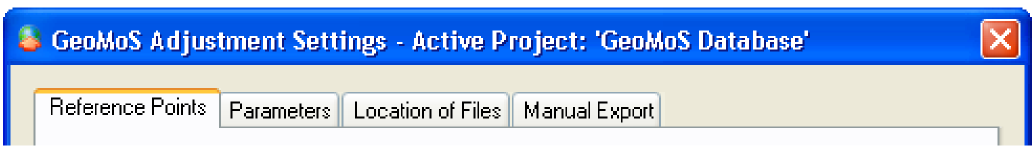
Data flow concept



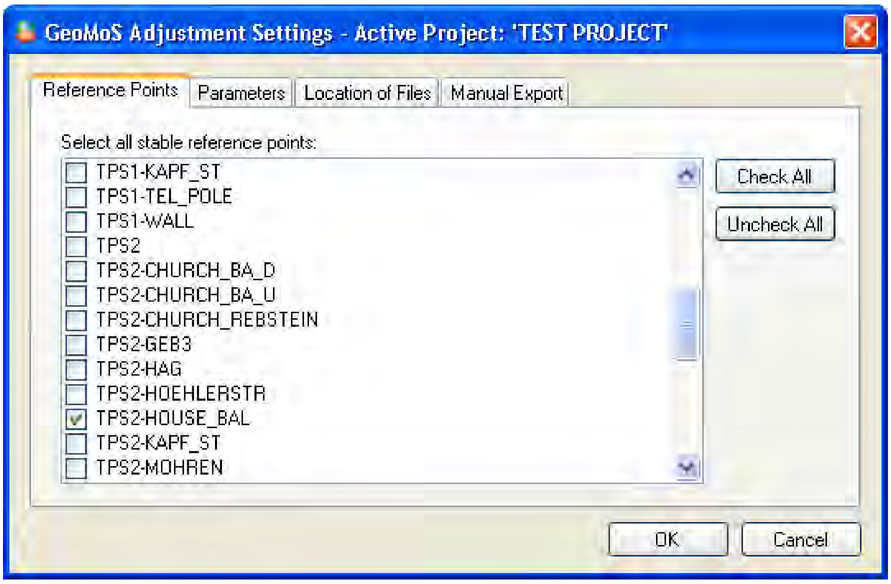
Configure automatic XML files for GeoMoS Adjustment

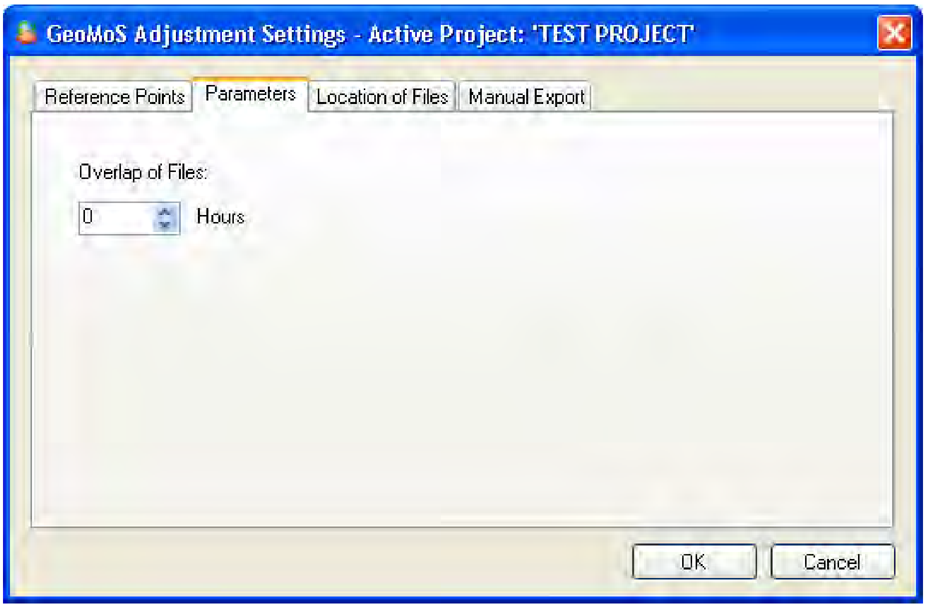
Follow these steps to configure XML files.

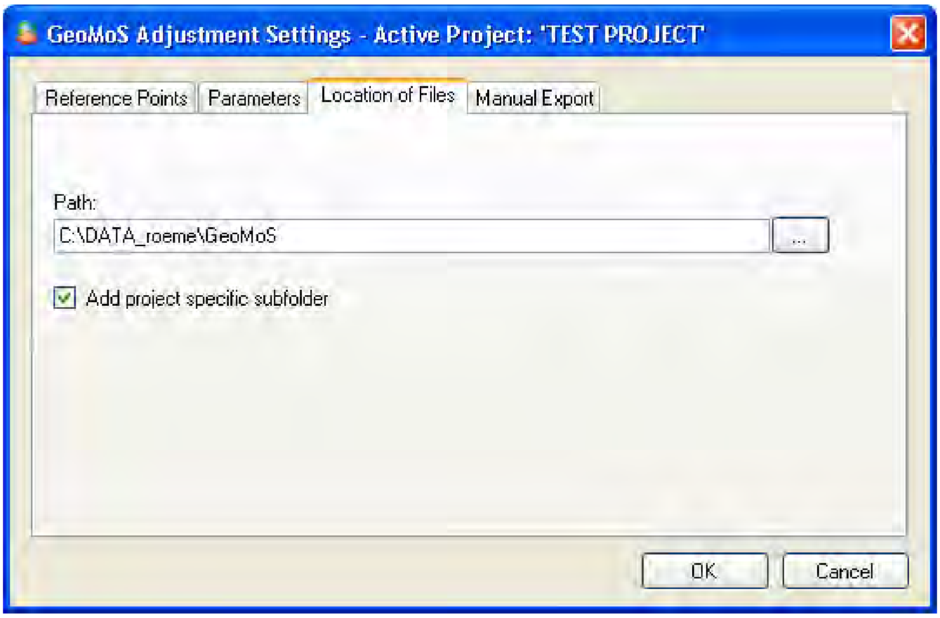
Step	Action
1	Select the menu **Services**, **Export to GeoMoS Adjustment...**.
2	The **GeoMoS Adjustment Settings** dialog will be displayed.
3	Switch with the **Tabbed-View** to the **Reference Points** tab. ▪ Select the reference points that are assumed to be stable
4	Switch with the **Tabbed-View** to the **Parameters** tab. ▪ Select the overlap with the previous file
5	Switch with the **Tabbed-View** to the **Location of Files** tab. ▪ Select the path to the files. GeoMoS Adjustment should be configured to read from this directory.
6	Switch with the **Tabbed-View** to the **Manual Export** tab. ▪ In case you need to process data history you can select the start and end time with the XML file length. Press **OK** to save the settings and close the dialog.
7	Select the menu Configuration, **Measurement Cycle Editor...**.
8	The **Measurement Cycle Editor** dialog will be displayed. Press **Insert...**. A new line appears and the XML Export can be added as Action to the measurement schedule. Press **OK** to save the settings and close the dialog.



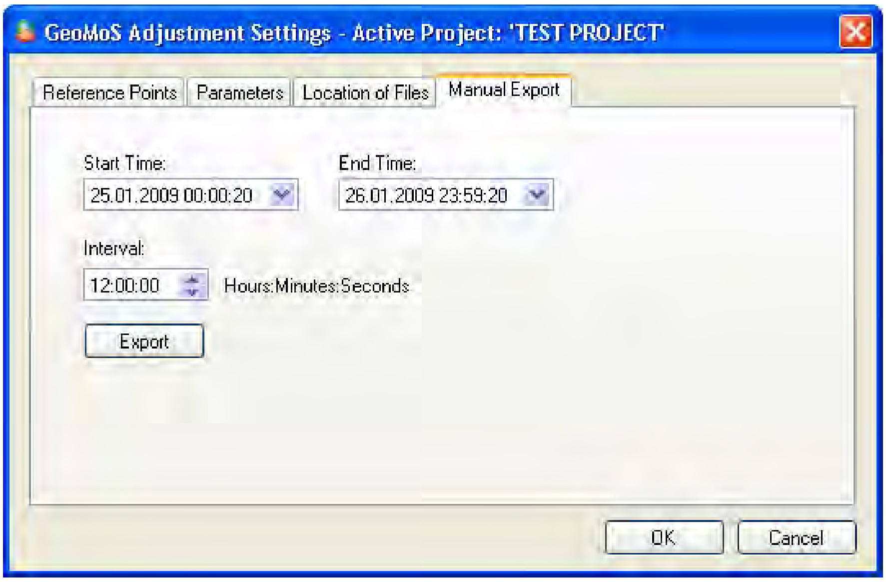
The table below describes the fields in the GeoMoS Adjustment Settings dialog box.

Field	Description
Reference Points	
List	This list displays per default all point names that are measured with the measurement mode ATR or ATR (small field of view). It is important to pre-define reference points that are assumed to be stable. The minimum number or required reference points depends on the mathematical geometry of the measured network. The pre-defined reference points will be considered in **GeoMoS Adjustment** depending on the selected network adjustment model (minimum constraint or reference points as fixed).

Parameters	
Overlap of Files	This value defines the time that a GeoMoS XML file will overlap with the previous file. For example, if an **Interval** of 4 hours and an **Overlap of Files** of 1 hour is entered, the GeoMoS XML file will be repeatedly exported every 4 hours starting from the start time. The total data that is included in the GeoMoS XML file is 5 hours.

Location of Files	
Path	This path defines the location of the manual or automatic exported files. The identical path must be defined in the Leica GeoMoS Adjustment software for automatic mode. The Leica GeoMoS Adjustment software checks at a defined

	interval for new GeoMoS XML files.
Add project specific subfolder	This checkbox creates a project specific subfolder in the above defined path. The purpose of this check is to avoid the accidental importing of different project specific GeoMoS XML files.

Manual Export	
Start Time **End Time**	Defines the time when the manual GeoMoS XML file will be exported.
Interval	The interval defines the time period, calculated from the start time, at which the GeoMoS XML will be repeatedly exported. For example, if an Interval of 4 hours is entered, the GeoMoS XML file will be repeatedly exported every 4 hours starting from the start time. It is recommended that the Interval is entered as an even fraction of a day, so that the exports always occur at the same time of day.
	Press **Export** to manually export GeoMoS XML files during the defined start and end time with the interval to the configured path.

Terms & Definitions

Term & Definition	Description
Mathematical model	The mathematical model describes the **network geometry** of the observations as an equation of parameters.
Stochastic model	The stochastic model describes the precision of the observations and the correlations. The differences of the mathematical observations and their true values are called the corrections or residuals.
Least squares method	The least squares method is based on the **normal distribution**. This is the most common adjustment method. The least squares method will fit the observations into their mathematical model whilst minimizing the sum of squares of the residuals.
Reference points	The reference points are assumed to be stable. The pre-defined reference points will be considered in **GeoMoS Adjustment** depending on the selected network adjustment model (minimum constraint, reference points as fixed or reference points as fixed). The datum is related to the reference points.
Monitoring points	The monitoring points are assumed to be unstable.
Datum	The observations must be related to a reference frame on earth with the mathematical definition, the so-called datum. The datum is based on the initial coordinates and geometry.
Free adjustment or **minimum constraint**	The network is adjusted without destroying the inner constraints of the mathematical model. The coordinates of the reference points get a correction. The standard deviations of the reference points get a variance.
Weighted constrained adjustment or **reference points as fixed**	The network is adjusted without destroying the inner constraints of the mathematical model. The coordinates of the reference points get a correction. The standard deviations of the reference points get a variance up to a defined limit.
Absolute constrained adjustment	The network is adjusted and the inner constraints of the mathematical model may be slightly changed. The coordinates of the reference points do not change. The standard deviations of the reference points are fixed to zero.

Variance factor estimation	A posteriori variances are estimated close to sigma 0 = 1. With this condition the parameters can be compared and used for further statistical analysis.
S-Transformation	The S-Transformation is used to switch the datum to a different base without adjusting the network again. The base is the reference points (initial coordinates) and with their geometry. Within the deformation analysis, the S-Transformation is required to compare epoch by epoch, the identical base.
Two-step strategy	The deformation analysis is based on the two-step strategy. All measured points are sorted in either stable reference points or unstable monitoring points. Step 1 adjusts the epoch with identical reference points. Step 2 compares two epochs against each other. The identical reference points are absolutely required, because non-identical network geometry (**mathematical model**) causes significant differences in the results of a network. In addition the identical **stochastic model** is computed with a variance-covariance estimation.
Testing (Fisher test, ...)	Reference points with significant movements will be eliminated out of the stable reference point group. Monitoring points are statistically tested against significant displacements. Stable monitoring points are added to the group of reference points.

Measurement

Automatic Measurement

Background information

The automatic measurement mode is fully automatically, until the Administrator ends the process. The various measurement cycles and related computations and limit checks are continually controlled by the system time (timer). The automatic measurements can be started from the GeoMoS Monitor. Before the automatic measurements can be started, there must be at least one Point Group with type Normal defined in the Measurement Cycle editor.

Start

Step	Action
1	Select the menu **Measurement**, **Start automatic, or click** the toolbar **Start button** .
2	The automatic measurements will be initialized and the configuration (Points, Profiles, Limits, Options) will be loaded. The special system Control Groups for Tolerance Exceeded and Repeat Measurements will be re-initialized.
3	The measurement time defined for the Point Groups in the Measurement Cycle Editor will be checked respectively with the Priority of the individual Point Groups. When the measurement time for a point group is reached the measurement cycle will be started and the first point in the point group will be automatically pointed to and measured.
4	The raw measurements will be checked for plausible errors (Point blunder checks, Standard Deviation). All points that are not measured or do not pass the plausibility checks will be automatically added to the system Control Group **Tolerance Exceeded** and will be measured at the end of the normal point group.
5	Depending on the selected Meteo Model, the meteorological data will be collected and a **Correction** will be calculated for the measurements.
6	The results are calculated and the tolerance checks made (depending on the active tolerance checks). When a **Tolerance Limit is exceeded** a status message will be generated and the point will be added to the system Control Group **Repeat Measurements**. The system point groups (Control Groups) for Tolerance Exceeded and Repeat

	Measurements will be measured at the end of the point group with the type Normal. They are assigned the lowest priority.

Stop

Selecting **Stop** will end the current measurement and complete the computation and tolerance checks for the current measurement and send any outstanding status messages. The status messages and data will be saved and the system Control Groups for Tolerance Exceeded and Repeat Measurements will be re-initialized. After a Measurement Cycle is stopped the system information is re-initialized.

Pause/Continue

Selecting **Pause** will interrupt the measurements at the current state of the Measurement Cycle. When a measurement to a point is in progress it will be completed before the measurement cycle is interrupted. When the system is in the Pause state, it is possible to continue or stop the measurement cycle. To continue the measurement cycle, press the **Pause** button again. When the system is paused for more than 10 minutes, the system will automatically reactivate the measurement cycle. The measurement process is continued from the next measurement or action and not re-initialized.

> **Attention:** Pausing the measurement cycle can lead to delays in the scheduled times or in extreme cases bottle necks in the measurement process.

Measure Point Group

This button is used for Manual Measurement.

Manual Measurement

A individual point group can be selected and measured. The function is only possible when the automatic measurement process is inactive. Manual measurements are useful to check the measurement cycle of a point group after the points have been learnt.

Step	Action
1	Select a **Point Group** from the list in the main window.
2	Select the menu **Measurement**, **Start/Stop Point Group**, **or click** the toolbar button **Measure Point Group** .
3	Click the toolbar button again or select the menu **Measurement**, **Start/Stop Point Group**, to stop the measurement of the point group.
4	The results are calculated and saved in the database.

Measurement Priority

Background information

The various Point Groups have different priorities in the measurement sequence. The priority determines the behavior of the system in the case that there is an overlap in the scheduling of the measurements in the Measurement Cycle Editor.

Priority for the various Point Group Types

Priority		Types
1	High	Freie Station Distance Intersection Orientation Only PPM Vz Correction
2	Middle	Special
3	Low	Normal Repeat Measurements Tolerance Exceeded

- Every point group is assigned a type which defines the priority of the measurements (3 levels: 1 = highest and 3 = lowest priority). The point group types for FreeStation,

PPM, Orientation Only and Vz Correction have priority 1, the point group type Special has priority 2 and the point group type Normal has priority 3. The system control groups, Tolerance Exceeded and Repeat Measurements, have priority 3.

- Groups that have the same priority and the same start time will be measured sequentially, in alphabetical order based on the point group name.
- The Tolerance Exceeded point group will be measured before the Repeat Measurement point group.
- The measurement sequence of point groups with overlapping time period is decided according to the priority. When point groups have the same priority the current point group will continue to measure. When a point group with a higher priority is ready to measure, the lower priority group will be interrupted and continued after the higher priority group has finished measuring.

Point Groups with Type Normal

A point group with the type Normal must exist at least once in the measurement cycle. The automatic measurements can not be started if a Normal point group does not exist in the measurement cycle. The measurements from the point group with type Normal, should be configured as the main point group of the measurement cycle. The control point coordinate calculations and other point group measurements, such as FreeStation, PPM, Orientation Only, Vz Correction and the Tolerance Exceeded and Repeat Measurements are executed in relation to the Normal point group. The control point coordinate calculations and the Tolerance Exceeded and Repeat Measurements can be configured in the **Options** dialog.

Point Groups with Type Free Station or Distance Intersection

When a point group with the type FreeStation or Distance Intersection is measured, the control point coordinates will be calculated when the point group has been measured. If the option to calculate the control point coordinates is also set in the **Options** dialog, then the coordinates of the control point will be calculated at the beginning of the point group with the type Normal according to the settings in the **Option** dialog. The point group with the type FreeStation/DistanceIntersection has the highest priority and will not be interrupted by other overlapping point groups in the measurement cycle. If the FreeStation + Orientation has been selected in the **Options** dialog, then the orientation of the Total Station will also be updated when the FreeStation/DistanceIntersection point group is measured.

Point Groups with Type PPM

This point group contains the points that are measured for the Reference Distances and can be set to measure at a regular interval. By comparing the measured distances with the calculated reference distances the PPM scale factor can be calculated, which can be used to correct the subsequent measurements. The reference distance is calculated between the control point and the target points contained in the PPM group. The PPM point group has the highest priority and will interrupt any overlapping point group in the measurement cycle.

Point Groups with Type Orientation Only

This point group contains the points that are measured for the Orientation of the Total Station and can be set to measure at a regular interval. The orientation calculation uses the coordinates of the Total Station control point and the measured reference points in the Orientation Only point group to determine the orientation of the instrument using a robust least squares solution. The Orientation Only point group has the highest priority and will interrupt any overlapping point group with a lower priority in the measurement cycle.

Point Groups with Type Vz Correction

This point group contains the points that are measured for the Vz Correction of the vertical angle and can be set to measure at a regular interval. The Vz Correction calculation uses the coordinates of the Total Station control point and the measured reference points in the Vz Correction point group to determine the vertical angle correction. The Vz Correction point group has the highest priority and will interrupt any overlapping point group with a lower priority in the measurement cycle.

> **Note:**
>
> The Vz Correction is essentially an estimation from the refraction effects which change according to atmospheric conditions. It is essential that measurements taken using this correction technique are measured within small time intervals and that the Total Station control point and the reference points used in the Vz Correction point group are absolutely stable. This correction should only be used in cases where variations in the measurements are specifically identified with refraction problems related to the vertical angle measurements.

System Control Point Groups for Tolerance Exceeded and Repeat Measurements

The point groups for Tolerance Exceeded and Repeat Measurements are controlled internally by the system. They are activated using the "Remeasure Points that could not be measured" and "Remeasure Points that were not within limits" options in the Normal Point Group

Properties. The points contained in these point groups and the measurement times are not user definable.

The **Tolerance Exceeded point group** contains all the points that have exceeded the defined limit and created a limit exceeded message.

When a point cannot be measured or the measurement to a point produces the messages "Point not found", "Point out of tolerance" or "Positioning failure", the point will be included in the **Repeat Measurement point group**. A point that produces the message "Blunder tolerance" is not included in the Repeat Measurement point group.

The point groups for Tolerance Exceeded and Repeat measurements will be executed at the end of the point group with type Normal. The two point groups have the lowest priority. The point groups are re-initialized before every point group with the type Normal is measured and then dynamically defined during the measurement process.

Tools

Point Viewer

Background information

The point viewer lists the 5 coordinate types used by GeoMoS (Null, Reference, Current, Scan, Setup) for each point. It is useful especially for checking the Null coordinate that is set. See Coordinate Types for further information.

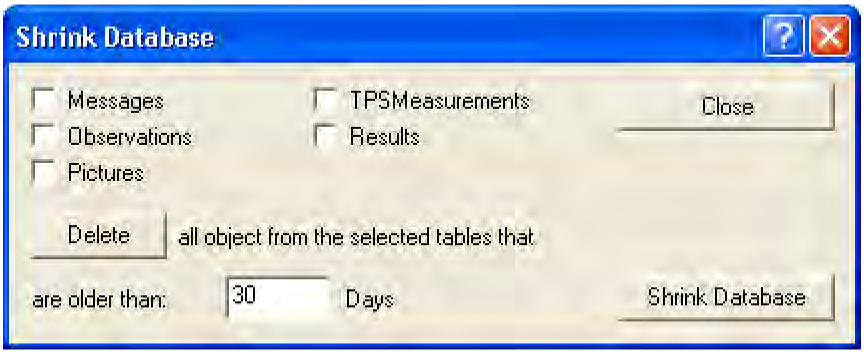
To open the Point Viewer

Step	Action
1	Select from the menu **Tools**, **Point Viewer** .
2	The **Point Viewer** window is displayed.

Shrink Database

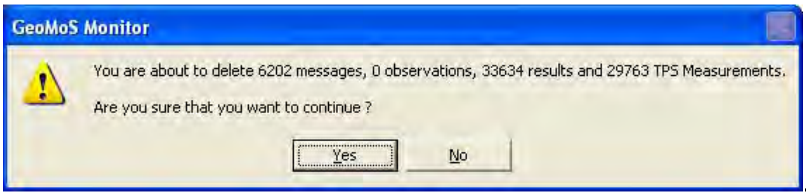
To open Shrink Database

Step	Action
1	Select from the menu **Tools**, **Shrink Database.**
2	The **Shrink Database** window is displayed.



The table below describes the fields and buttons in the Shrink database dialog box.

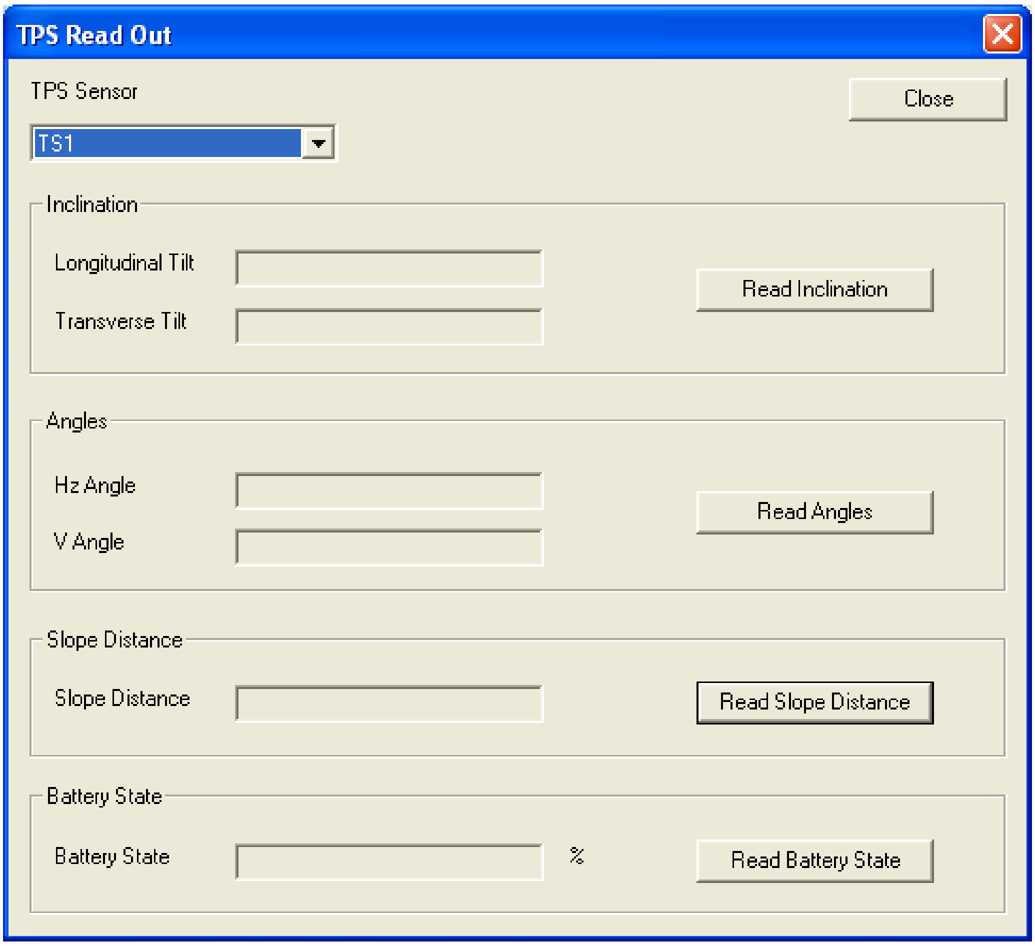
Field/Button	Description
Messages	Check this option to enable deletion of messages older than the specified age.
Observations	Check this option to enable deletion of observations from non-TPS sensors older than the specified age.
TPS Measurements	Check this option to enable deletion of Total Station measurements older than the specified age.
Results	Check this option to enable deletion of results older than the specified age.
Images	Check this option to enable deletion of webcam images older than the specified age.
	Deletes all of the checked items that are older than the specified age. A confirmation message is given after the delete button is pressed.

	 **Note:** Deleting records from the database will not free disk space. After doing a delete the **Shrink Database** button should be used to free disk space.
 	Removes blank parts of the database resulting from deleted records, reducing the disk usage.

TPS Read Out

To open the TPS Read Out

Step	Action
1	Select from the menu **Tools**, **TPS Read Out.**
2	The **TPS Read Out** window is displayed.



The table below describes the fields and buttons in the TPS Read Out dialog box.

Field/Button	**Description**
TPS Sensor	Select the active total station sensor.

Inclination	
Longitudinal Tilt	The current tilt in the longitudinal direction (the direction the Total Station is pointing).
Transverse Tilt	The current tilt in the transverse direction (orthogonal to the direction the Total Station is pointing).
Read Inclination	Press this button to read the inclination measurements from the Total Station.

Angles	
Hz Angle	The current horizontal angle.
V Angle	The current vertical angle.
Read Angles	Press this button to read the angle measurements from the Total Station.

Slope Distance	
Slope Distance	The current slope distance to the target.
Read Slope Distance	Press this button to read the slope distance from the Total Station.

Battery State	
Battery State %	The battery capacity of the currently used battery or external power source as a percentage.
Read Battery State	Press this button to read the battery status from the Total Station.

Help

Help Topics

The help topics of the **GeoMoS Analyzer** application will be shown:

Step	Action
1	Select the **Menu ?**, **Help Topics**.
2	The **Help** dialog appears.
3	Search for the topic you are interested in and close the **help** dialog.
4	The dialog **Help** will be closed.

The **help** dialog can be used to read through the topics listed in the content window, to quickly go through the index or to search the help using key words.

View Licenses

Topic contents

Background Information

The **Leica Geosystems Software Licensing** is based on a reliable and secure technology, that does not require a **Software Protection Key (Dongle)**.

The new **Leica Geosystems Software Licensing** requires an **Entitlement ID**, for example: 00101-60609-00013-85723-8FF41

The Entitlement ID can be found on the Invoice and on the Delivery Note of the purchased software product. In addition it can be also found on a separate Entitlement Certificate, on paper or in digital form. (i.e. HTML document).

Leica GeoMoS uses the License Model **"Floating"**. Floating licenses can be shared between multiple users working on different PCs within the same local network. When one user finishes using a license, another user can begin to use it.

The Floating Licenses are managed by a **Local License Server** running in the customer's network called CLM Administrator Server.

Important:

- You need an active Internet connection to activate and update your license. Once installed and activated this internet connection is no longer required.

For more detailed information about the new Leica Geosystems Software **Licensing** please refer to the document

- **Leica Geosystems Software Licensing Introduction & Installation**.

www.leica-geosystems.com/geomos --> Select the Download tab

GeoMoS software License Models and function

The availability of different **License Models** and their **function** depends on the Leica Geosystems Software product.

The following license models and functionality is **supported**:

- Floating licenses
- Re-hosting (1 per year)

The following license models and functionality is **not supported**:

- Node-locked licenses
- Borrowing of floating licenses

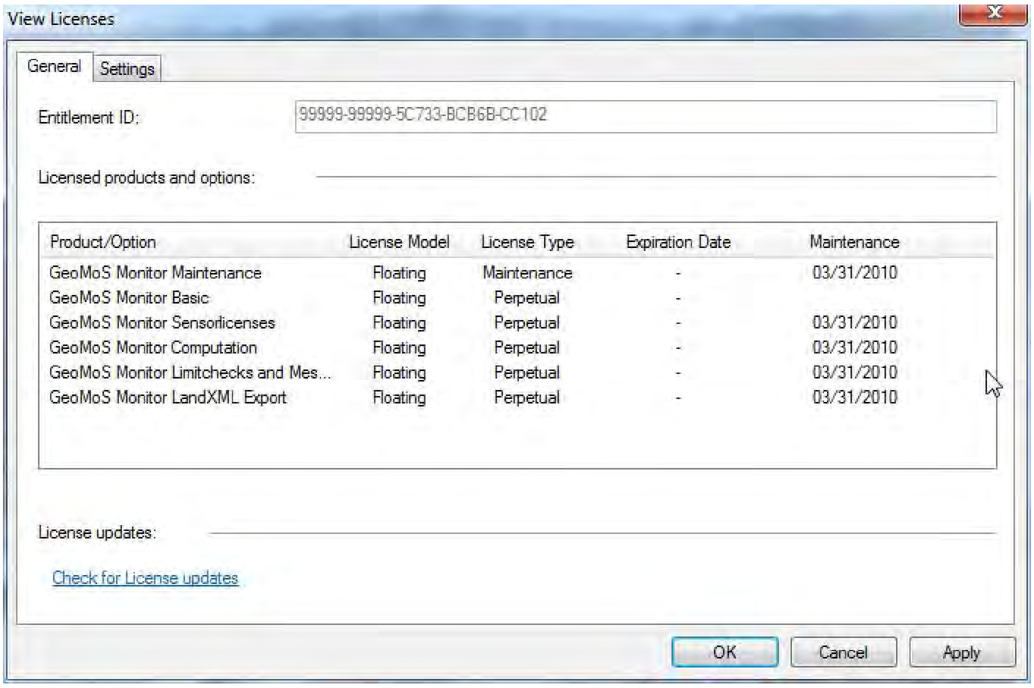
View Licenses dialog

Follow these steps to view the currently activated **Licenses**, the **License Server** and the **Proxy Server Settings**.

Step	Action
1	Select the menu **Help**, **View Licenses**.
2	The **View Licenses** dialog will be displayed.
3	Select the **General** tab.
4	The **View Licenses** dialog shows the **Entitlement ID** and all currently **activated**

	options of the software package.

Note: For viewing the currently activated licenses the connection to the internet is not required



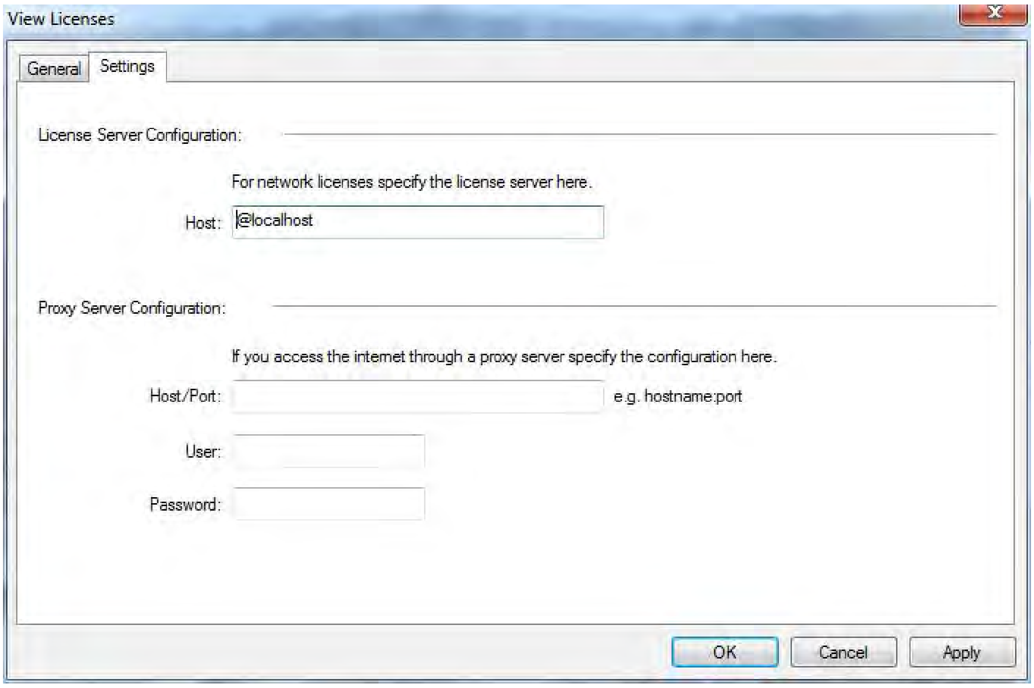
Field/Button	Description
Entitlement ID	The **Entitlement ID** is the software key.

Licensed products and options	
Product/Option	The name of the product/option. Lists all currently activated options of the software package.
License Model	The license model. GeoMoS software products use only Floating licenses.

License Type	The license type. The following license types are available: ▪ maintena nce ▪ perp etual
Expiration Date	The expiration date. It is not possible to use the software product after the expiration date.
Maintenance	The maintenance date. It is not possible to install software product with a release date behind the maintenance date. The software product is still functioning after the maintenance date.
License update	
Check for License updates	To check for newly purchased software options or software maintenance. If no License Updates are available the message "No new licenses are available" appears. If License Updates are available the message "New floating licenses are available, please contact your license server administrator" **Note**: For this function the internet connection is required, to allow connection to the Leica Geosystems License Server.

OK	Press **OK** to save the settings and close the dialog.
Cancel	Press to **cancel** and close the Data push to GeoMoS Web dialog.
Apply	Press to **apply** to save the settings before you select the **Settings** tab.

Step	Action
5	Select the **Settings** tab.
6	The View Licenses dialog shows the **License Server** and the **Proxy Server Settings** of the software package.



Field/Button	Description
License Server Configuration	
License Server	Shows the Local License Server name Address (IP-address and port) or host name (computer name). The Local Clients product software connects to this Local License Server to retrieve products/options.

Proxy Server Configuration	These settings are only important if you use a proxy server for your LAN.
Host/Port	Enter the proxy server with IP-address and port.
User	Required authentication for your proxy server.
Password	Required authentication for your proxy server.

OK	Press **OK** to save the settings and close the dialog.
Cancel	Press to cancel and close the Data push to GeoMoS Web dialog.
Apply	Press to **apply** to save the settings before you select the **General** tab.

About GeoMoS Monitor

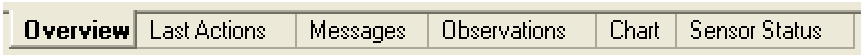
Displays the version and build information of GeoMoS.

Tabs

Tabs

Upon opening GeoMoS Monitor, tabs at the bottom of the view allow you to quickly switch from one view to another.

Tabs



Select from the menu **Configuration,** **Customize** to change the settings.

Overview

Background information

The most important system information about the Monitoring System is displayed on the first tab view called Overview. A summary of the status of the Monitoring System is displayed. The information will be updated after every measurement. Information on individual sensors is shown in the Sensor Status.

Measurement Process

Status

The Status of the measurement process is displayed. The following conditions are possible:

- Active: The Total Station image turns, points and measures to the prism with a red line.
- Stopped: The Total Station image is not moving, and a stop sign is displayed between the Total Station and the prism.
- Paused: The Total Station image is not moving, and a flashing stop sign is displayed along a line between the Total Station and the prism.

Last Message

Displays the most recent message that were generated by the system. In addition the message must be selected to be acknowledged in the Message Configurator dialog. A special symbol is displayed for every message (limit exceeded, power failure, burglary), the time and status message text. The symbol will be changed when the message is cancelled via the right mouse menu or reset by the software to indicate that the message has been acknowledge.

Acknowledge All of This Type

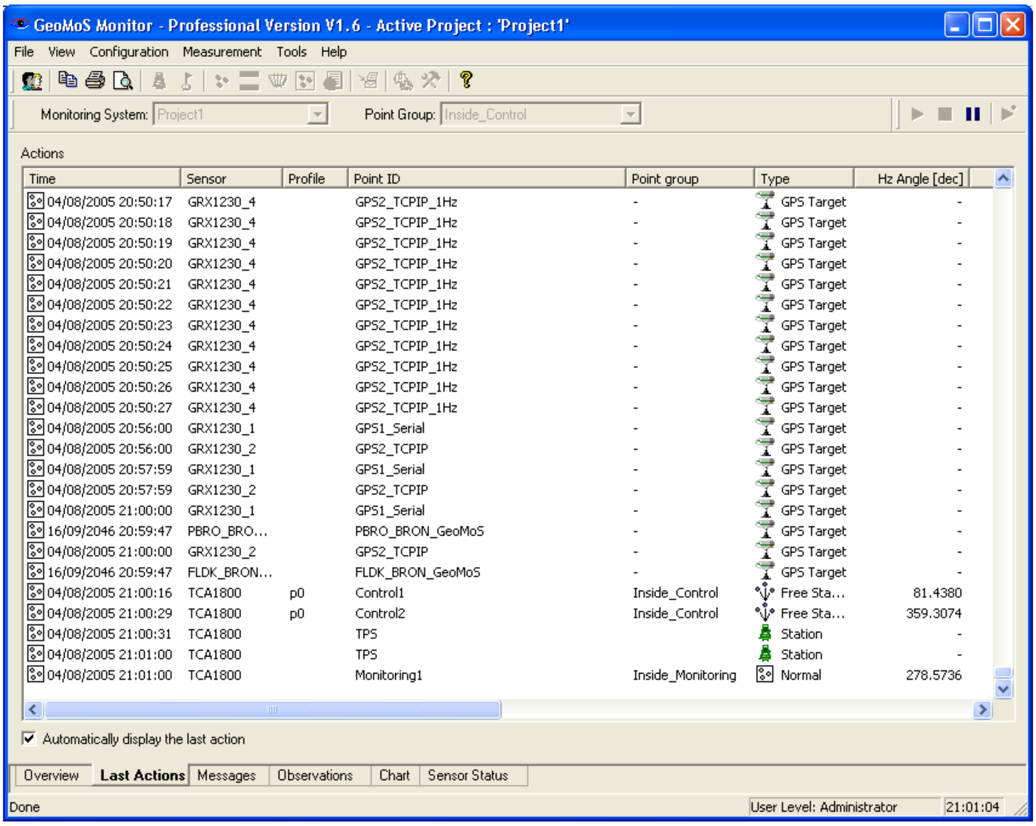
Pressing this button will acknowledge all messages of the type displayed in the Last Message section above.

Last Actions

Background information

This table displays the actual results from the last 100 position measurements of the current Monitoring System. The duration that status measurements are displayed in the table can be defined, in days, in the Customize dialog under the **Panes** options. The Time column can be sorted to display the newest results at the top or the bottom of the table.

Except for the first column all other columns can be hidden or shown as required. All columns can be sorted as required.



The table below describes the fields in the Last Actions tab.

Field	**Description**
Time	The time of the action.
Sensor	The sensor performing the action.

Profile	The profile that the point belongs to.
Point ID	The name of the point being measured.
Point Group	The name of the point group being measured.
Type	Station update GNSS target For additional sensor see [Point Editor - Types](#). Normal, special or PPM point group Free station or distance intersection point group Orientation only point group Vz correction point group
Hz Angle [dec]	The measured horizontal angle.
V Angle [dec]	The measured vertical angle.
Slope Distance [m]	The measured slope distance.
3D Vector [m]	The total displacement from the null measurement.
Longitudinal Displacement [m]	The displacement from the null measurement in the longitudinal direction.
Transverse Displacement [m]	The displacement from the null measurement in the transverse direction.
Height Displacement [m]	The displacement from the null measurement in the height direction.
Easting [m]	The calculated easting of the point.

Northing [m]	The calculated northing of the point.
Height [m]	The calculated height of the point.

Automatically display the last actions	If selected the view will be automatically scrolled to show the most recent message.

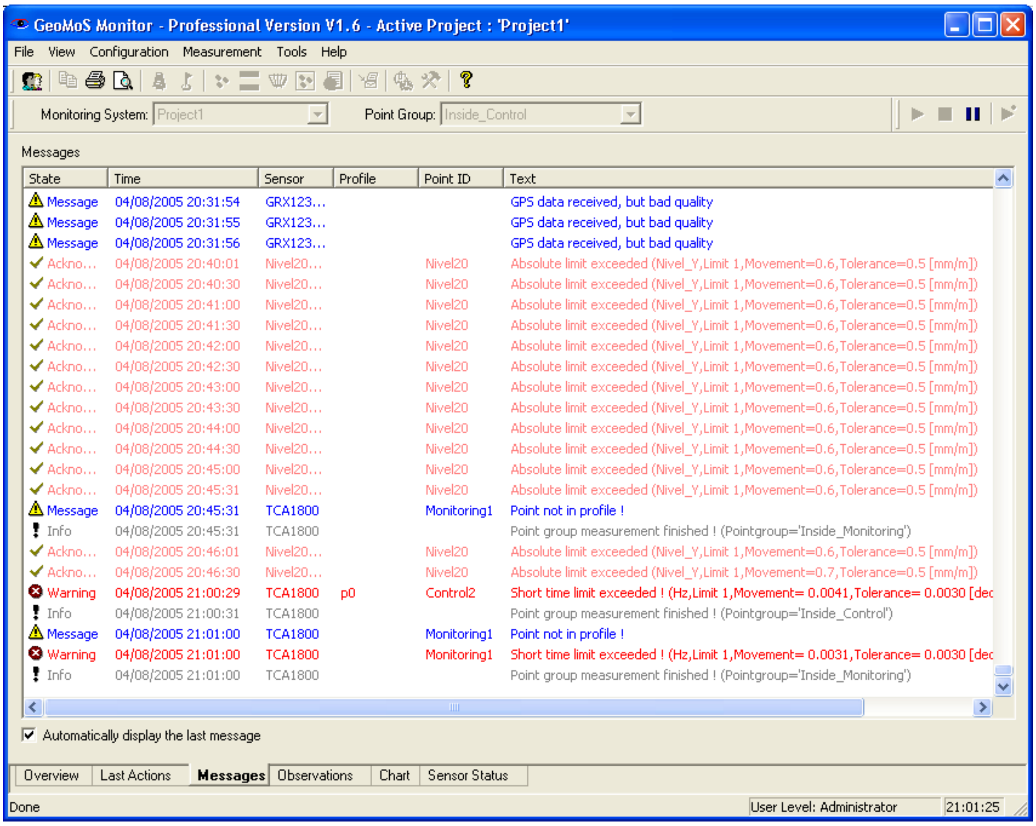
Messages

Background information

The status and error messages are displayed with date and time. The duration that status messages are displayed in the table can be defined, in days, in the Customize dialog under the **Panes** options. The columns can be sorted by time, so new messages are displayed at the top or bottom of the table.

When the system generates messages for limit checks or other system conditions they will be displayed in the table. The time of occurrence for all messages is held fixed. Messages that are related to point observations will also display the information about the Point ID and Profile in the relevant columns.

When a protocol printer is connected, it can be activated or deactivated in the Customize dialog. When the protocol printer is active all messages will be also be printed. A signal tone can also be activated to sound for the messages.



The table below describes the fields in the Messages tab.

Field	Description
State	Individual messages are displayed with a particular icon. Information messages are displayed with an exclamation mark Messages are displayed with an exclamation mark in a yellow triangle. Messages cannot be acknowledged. Messages that have been manually acknowledged are displayed with a green tick mark Messages that are acknowledged automatically are displayed with a black tick mark Warning messages are displayed with a white cross on a red circle. Warning messages can be manually or automatically acknowledged. **Acknowledgeable Messages:** The user must manually or automatically acknowledge acknowledgeable messages when the column Acknowledge is set to **Yes** and the symbol appears. **Not acknowledgeable Messages:** The column Acknowledge is set to **No** and the symbol appears.
Time	The time the message was generated.
Sensor	The sensor that is associated with the message.
Profile	The profile of the point associated with the message.
Point ID	The name of the point associated with the message.
Text	The message.

	Example *17.11.2009 17:37:07 EMail, B, TPS1200, Absolute limit check level 1 exceeded!* *(17.11.2009 17:37:07, 3D Vector, Movement: +0.029, Tolerance: 0.020[m])*

Automatically display the last message	If selected the view will be automatically scrolled to show the most recent message. **Note:** ▪ If a message occurs more than once during one minute the message will be displayed only once.

Acknowledge

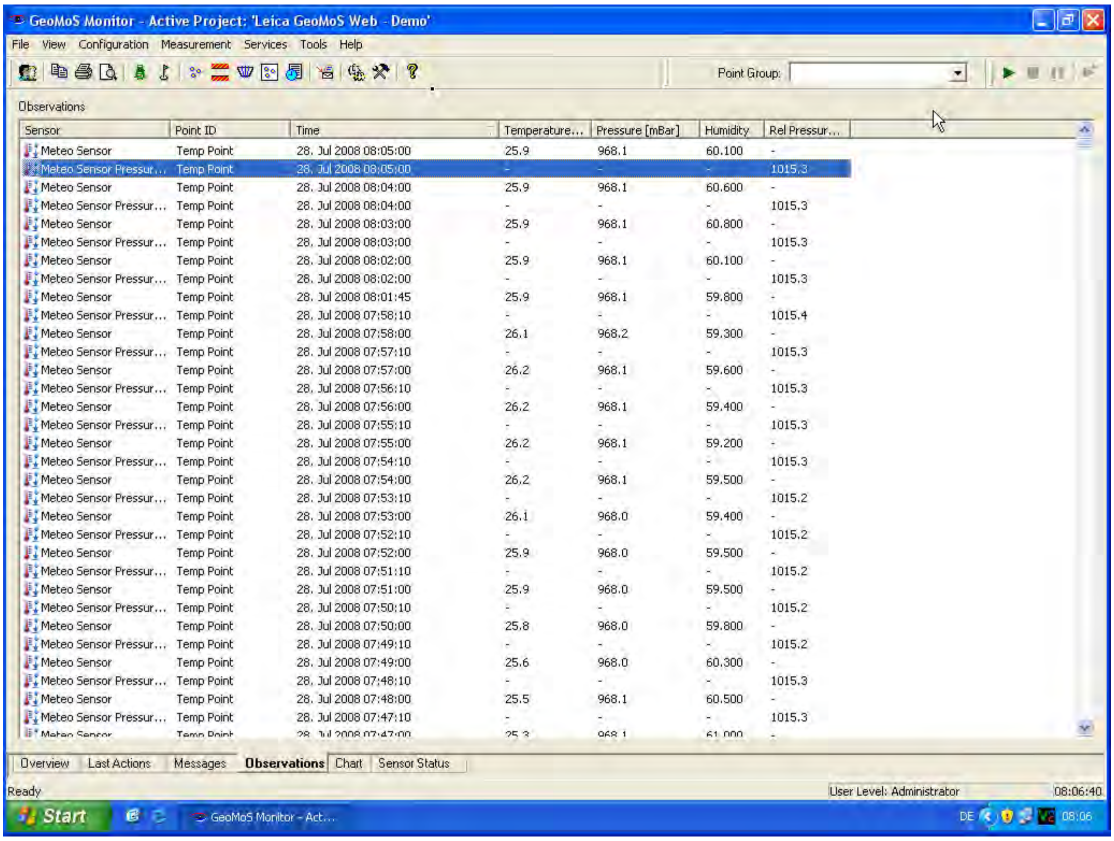
Messages can be user configured to be manually or automatically acknowledged. The message settings can be found in the menu **Configuration**, Customize dialog. Messages can be manually acknowledged using the right mouse function **Acknowledge**.

Observations

Background information

The table displays the individual measurements from the **Geotechnical Sensors** connected to the Monitoring System. Every Sensor can be assigned to a point in the **Sensor Location** dialog.

The current Meteo Model that is selected in the **Options** dialog is displayed below the table. Up to 10 temperature sensors can be connected. The Meteo Sensors must be first **initialized** in Sensor Manager in the Monitor application. The following information is displayed in the table:



Field	Description
Sensor	The name of the connected Sensor will be displayed.
Point ID	The Sensor is assigned to a point in the **Sensor Location** dialog. This Point

	ID will be displayed.
Time	The measurement time is displayed.
Values	These fields are dependant on the connected Sensor. For a temperature-pressure Sensor, the measured temperature and pressure values are displayed. Please follow this link for more information on the Standard system observation types.

Chart

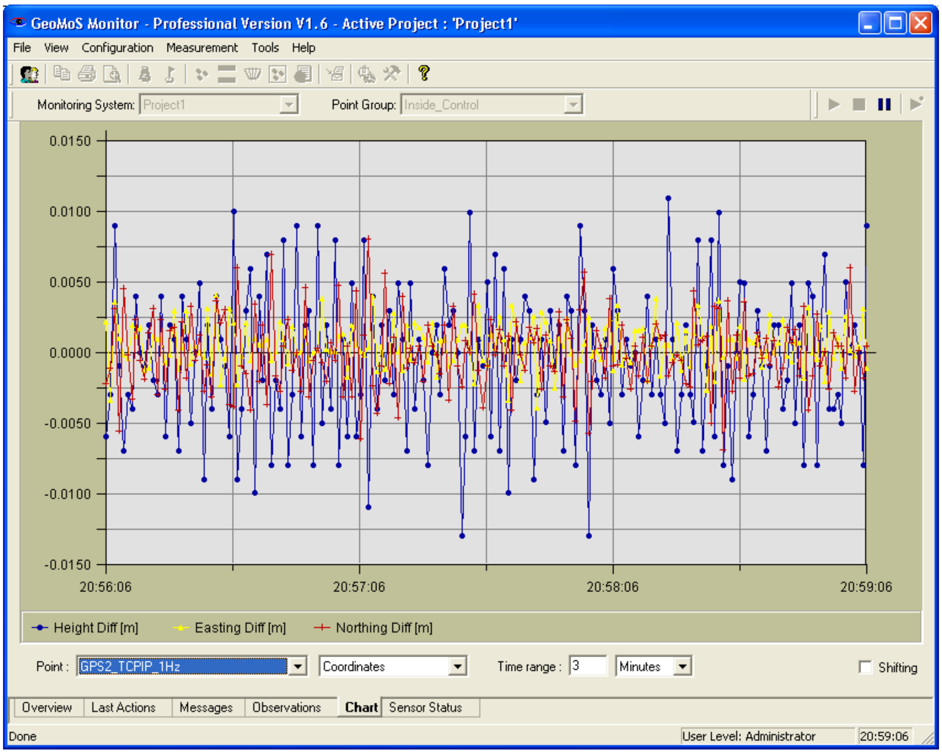
Background information

The chart shows the most recent measurement, coordinate and displacement results from total station, GNSS and meteo sensors.

Create a chart

Follow these steps to create a chart.

Step	Action
1	Select the Point to show in the graph.
2	Select the observation or result type to display. Only observation/result types with data will be listed.
3	Select the time range to display. The display shows from the current time back the specified range.



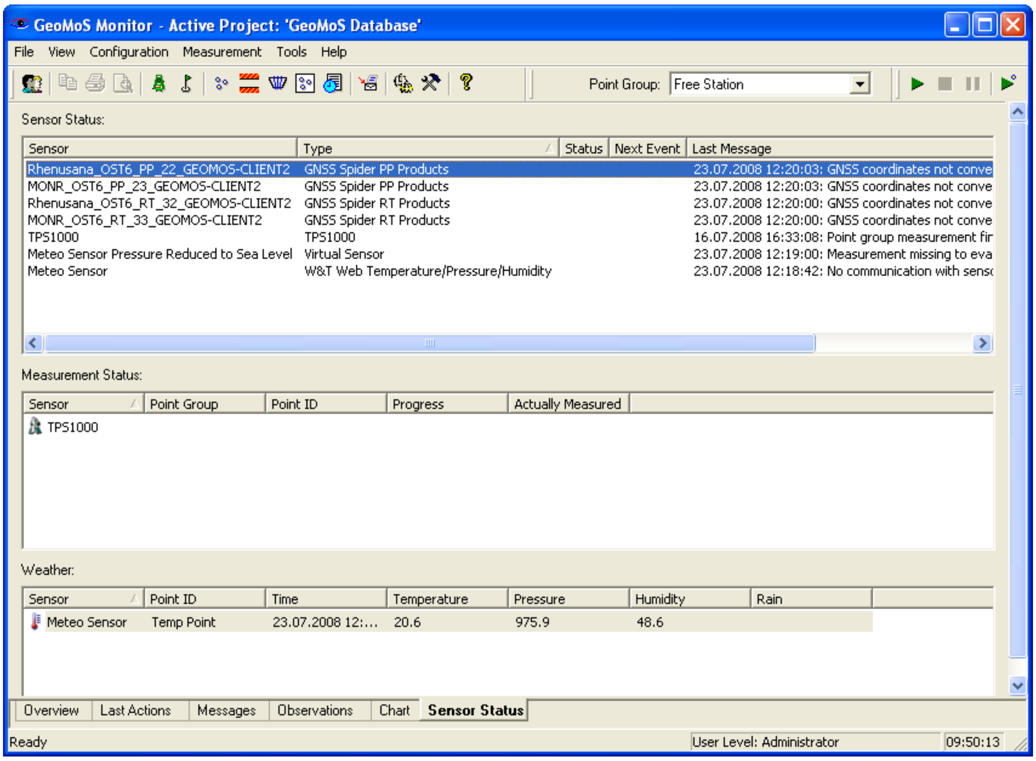
The table below describes the fields in the Chart tab.

Field	Description
Coordinates	The calculated coordinate difference of the point. **Note:** Coordinate difference = "Current" coordinate - "Null" coordinate
Displacements	The calculated displacements difference of the point.
Hz (Face I)	The measured horizontal angle only in Face I.
V (Face I)	The measured vertical angle only in Face I.
Hz/V (Face I)	The measured horizontal and vertical angle combined.
Point ID	Select the sensor location.
List box	Select the observation type. This field is dependent on the Point ID.
Time Range	Select the time range of the graph.
Shifting	Check or uncheck. Moves the current time stamp to the left.

Sensor Status

Background information

The Sensor Status tab gives an overview of the measurement and connection status of sensors connected to GeoMoS.



Field	**Description**
Sensor Status	
Sensor	The name of the sensor.
Type	The type of the sensor.
Status	The status of the sensor (active, measuring, waiting).
Next Event	The next scheduled event or measurement for the sensor.
Last Message	The last sensor generated by the sensor.

Measurement Status	This display shows measurement status of all total stations, which unlike other sensors are able to measure multiple points.
Sensor	The name of the total station.
Point Group	The name of the Point Group being measured or last measured by the total station.
Point	The name of the point currently being measured.
Progress	The progress of the measurement showing how many points in the point group of measured and the total number of points in the point group.
Actually Measured	The number of points in the point group which were successfully measured. Example: If the Progress of **10 / 10 [100 %]** and Actually Measured of **9 / 10 [90 %]** is displayed all points of the point group are measured and for any reason one point of the point group was not measured.

Weather	This display shows the most recent measurements from all meteorological (meteo) sensors connected to the system.
Sensor	The name of the meteo sensor.
Point	The name of the point where the meteo sensor is located.
Time	The time of the last measurement.
Temperature	The last temperature measurement.
Pressure	The last pressure measurement.
Humidity	The last humidity measurement.
Rain	The last rain measurement.

GeoMoS Analyzer

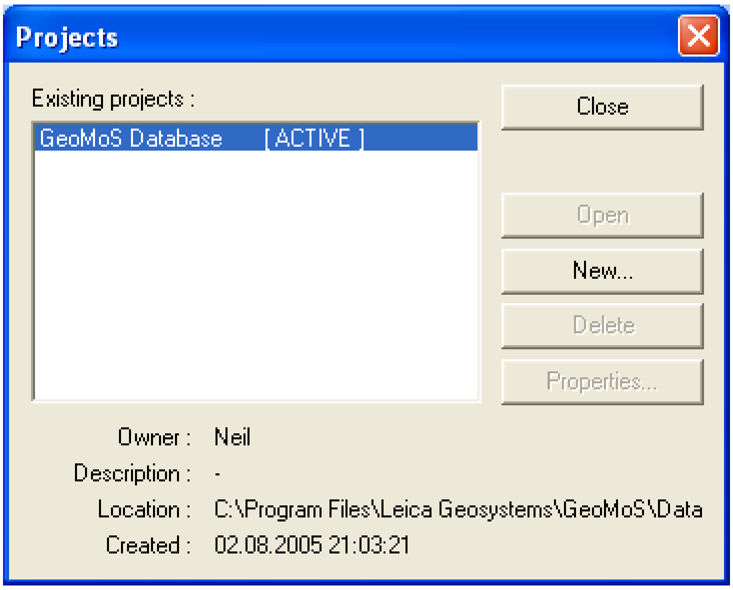
Menu

File

Projects

To open the Projects dialog

Follow these steps to open the Projects dialog.

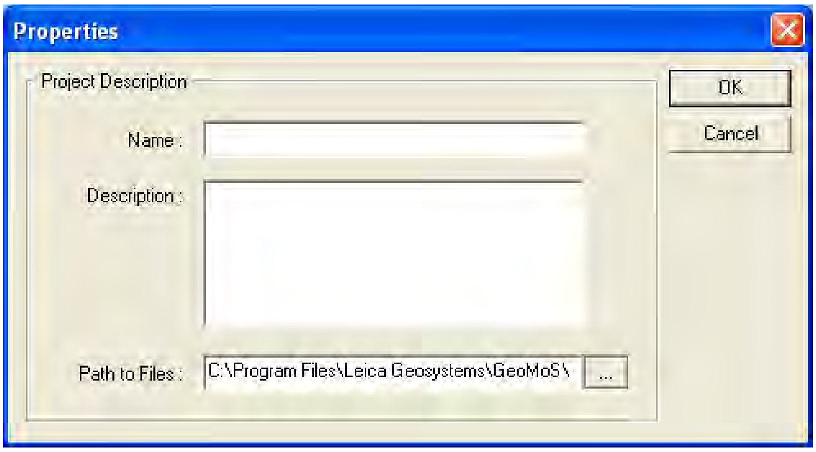
Step	Action
1	Select from the menu **File**, **Projects...**.
2	The **Projects** dialog is displayed. 

Project Settings

The table below describes the fields and buttons in the Projects dialog box.

Field/Button	Description

<table>
<tr><td>Existing Projects</td><td>A list of the existing projects.</td></tr>
<tr><td>Close</td><td>Close window.</td></tr>
<tr><td>Open</td><td>Opens the selected project.

Note: A different project may be open in both Monitor and Analyzer.</td></tr>
<tr><td>New...</td><td>


<table>
<tr><td>Name</td><td>Enter the name of the new project. This name will also be used as the name of the database.</td></tr>
<tr><td>Description</td><td>Enter a description of the monitoring project.</td></tr>
<tr><td>Path to Files</td><td>Select the path for the database files.

Important: Only local hard drives are permitted to store the GeoMoS Monitor database file.</td></tr>
</table>
</td></tr>
<tr><td>Delete</td><td>Delete the database. All data will be lost. It is not possible to delete the active project.</td></tr>
<tr><td>Properties...</td><td>Use this option to edit the name, description and the path of an existing project.</td></tr>
</table>

Export

Graphic

Background information

The graphs can be exported in EMF (Enhanced Metafile), Chart FX, Bitmap (BMP) or text format. The system exports the active visible view of the active pane.

Open the Graphics dialog

Follow these steps to open the Graphics dialog.

Step	Action
1	Select menu **File**, **Export**, **Graphic...** or press the **Export Graphic button** .
2	The **Export Graphic** dialog appears.
3	Select a **folder**, where the file should be stored and type in a **file name** (without extension). The extension will be added.
4	Press the **Save** button to create the file. The system closes the Export Graphic dialog and creates the export file with the selected graphic in the selected folder with the selected file name.

Vectors (CSV)

Background information

Using this menu option it is possible to output the key information, including times, coordinates and displacements, from the selected points as a comma separated ASCII file.

> **Note**: This export function works only for the Vector tab.

Open the Vectors dialog

Follow these steps to open the Vectors dialog.

Step	Action
1	Select menu **File, Export, Vectors (CSV)...**
2	The **Export** dialog appears.
3	Select a **folder**, where the file should be stored and type in a **file name** (without extension). The extension will be added.
4	Press the **Save** button to create the file.

DXF Vector Export

Background information

The displacement vector will be exported as vectors to a file in DXF format (microstation). The system exports the point identifier, the X/Y coordinates of the points and the length of the displacement vector as the Z coordinate.

Open the DXF Vector Export dialog

Follow these steps to open the DXF Vector Export dialog.

Step	Action
1	Select menu **File**, **Export**, **DXF Vector...**, or press the **Export DXF Vector button** .
2	The **Export DXF Vectors** dialog appears.
3	Select a **folder** where the system should store the file and type in a **file name** (without extension). The extension *.dxf will be added.
4	Press the **Save** button to store the file. The system closes the **Export DXF Vector** dialog, computes the displacement vector and creates an export file based on the selected points and the selected graphic options and stores it with the defined name in the defined folder. **Remark:** Comments will not be exported.

DXF Contours Export

Background information

The displacement vectors will be exported as contours into a file in DXF format (microstation). The system exports the contour lines, the calculated points of the contour interpolation and the labels.

Open the DXF Contours Export dialog

Follow these steps to open the DXF Contours Export dialog.

Step	Action
1	Select the points for export in the point view tree.
2	Select menu **File**, **Export**, **DXF Contour...** or press the **Export DXF Contours button** .
3	The **Export DXF Contours** dialog appears.
4	Select a **folder**, where the data should be stored and key in a **file name** (without extension). The extension *.dxf will be added.
5	Type in the contour interval for the contour lines.
6	Press the **Save** button to generate the export file. The system closes the **Export DXF Contours** dialog, computes the contour lines and creates an export file with the defined settings and stores it in the defined folder with the defined name. **Remark:** The contour lines will not be stored in the system. The contour lines are only computed for the export. Comments will not be exported. The defined time range and point selection will be used for the export.

Database

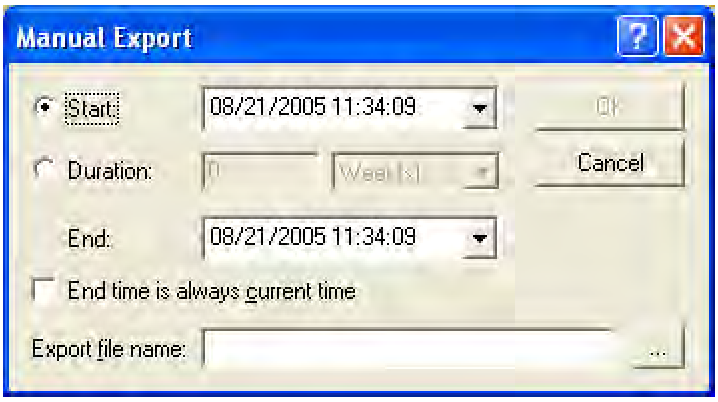
Export

The manual export of data can be done from GeoMoS Analyzer. The data can be exported manually.

To manually Export data

Follow these steps to manually export data.

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>From the File menu select Database, Export....</td></tr>
<tr><td>2</td><td>The Export dialog will be displayed.



<table>
<tr><th>Field</th><th>Description</th></tr>
<tr><td>Start</td><td>The date and time of the first data to be exported.</td></tr>
<tr><td>Duration</td><td>The period back from the current time to be exported. Only available if the "End time is always current time" option is selected.</td></tr>
<tr><td>End</td><td>The data and time of the last data to be exported.</td></tr>
<tr><td>End time is always current time</td><td>Sets the end time to the current system time.</td></tr>
</table>
</td></tr>
</table>

	Export file name — The name of the .DAT file to which the data will be exported.
3	Enter the time range where data should be exported.
4	Enter a path and file name where the data should be stored.
5	Click the **OK** button to exit this dialog.
6	All data of the selected time range will be exported. The data will not be deleted from the database. The dialog will be closed and the export file will be created in the selected directory. The data can be imported to the database. Only data older than the selected time range will be exported. The data will be exported, stored in the path and deleted in the database. The name of the exported data is 'GeoMoS Export date time.dat' (e.g. 'GeoMoS Export 19-October-2001 16-30-02.dat') The data can be imported to the database. **Remark:** The .dat file will be much smaller if it is zipped using WinZip or a similar tool.

Import Database

Background information

Already exported data (that does not exist in the database) can be imported to the database. The import does not overwrite existing data. Only new data (that does not exist in the database) will be imported and added to the database.

To open the Database Import dialog

Follow these steps to open the Import Database dialog.

Step	Action
1	From the **File** menu select **Database**, **Import...**.
2	The **Open** dialog will be displayed.
3	Select the file you want to import.
4	Click **Open** to import the file.
5	The dialog will be closed and the new or not existing data will be imported to the database and stored in the database.

User Level

Background information

There are three user levels which determine the functionality allowed by the operator in the system:

- Viewer
- User
- Administrator

The Administrator has full access to all functionality, while the User and Viewer have restricted access to the system, as shown in the table below. A password is required to change to a higher level of user access. No password is required to change to a lower user level. When the password is active, the application starts in the lowest user level status of Viewer. The password protection can be configured.

User Level	Rights
Viewer	▪ Restricted. ▪ Can view overview, last actions, messages and observations. ▪ Cannot make any changes to operation, configuration or close program.
User	▪ Restricted. ▪ Can start and stop measuring, edit points, point groups, profiles and measurement cycles. ▪ Cannot change critical settings such as limit classes, event messages, point coordinates, delete database records or close program.
Administrator	▪ Full.

Note: The User Level is configured independently for Monitor and Analyzer.

To open User Level:

Follow these steps to open the user level.

Step	Action
1	Select from the menu **File**, **User Level...** or click on the toolbar **User Level button** .
2	The **User Level** dialog is displayed.
3	Select the desired user level.
4	If the new user level is lower than the existing user level, then no further entry is necessary and the dialog can be closed by pressing the OK button. If the new user level is higher than the existing user level a **Password** dialog will be displayed automatically.
5	Enter the Password for the new user level and press the OK button. The password is case sensitive. The **User Level** dialog will be automatically closed if the password is correct.

The available functionality and access rights for the selected user level will be activated. The functionality that is not accessible for a particular user level will be grayed out. The current user level is displayed in the Status Bar.

Set Password

Passwords can be defined to protect the access to the various user levels. When Administrator is selected as the user level in the **User Level** dialog, the **Settings** button is active. The password for the User and the Administrator can be set in the **Set Password** dialog.

Follow these steps to set a Password.

Step	Action
1	Change to the user level to ’Administrator’.
2	Select the menu **File**, **User Level...**.
3	Click the **Set Password** button.
4	The **Settings** dialog is displayed.
5	Edit the passwords for User and Administrator.
6	Click the **OK** button.
7	The **Settings** dialog will be displayed again.
8	Repeat the entry for the passwords and confirm with the OK button.
9	The **Settings** dialog will be closed and the passwords will be saved.

After the second confirmation the passwords will be saved and activated. A password dialog will appear when changing to a higher user level. It is only possible to change the user level when the correct password for the respective user level is entered. When the password fields for the User and Administrator are empty, it is not necessary to enter a password to change between user levels. If only one password is entered the **Settings** dialog cannot be confirmed with the **OK** button.

Page Setup

To open Page Setup

Follow these steps to open Page Setup.

Step	Action
1	Select the menu **File**, **Page Setup...**.
2	The **Page Setup** dialog is displayed.
3	Select the preferred printer and change the print properties as required.
4	Confirm the selected printer and properties by pressing the **OK** button. The **Page Setup** dialog will be closed and the Page Setup settings will be saved.

Print Preview

To open Print Preview

Follow these steps to open the Print Preview.

Step	Action
1	Select from the menu **File**, **Print Preview**.
2	The **GeoMoS Monitor** print preview will be displayed. The window shows the active view with the defined page setup.

The buttons have the following functionality

Button	Description
Print...	Prints the current print preview.
Next	Shows the print preview of the next page.
Previous	Shows the preview of the previous page.
Two Pages / One Page	Shows one or two pages at a time.
Zoom Out	Zooms out.
Zoom In	Zooms in.
Close	Closes the print preview window and returns to the application.

Print

To open the Print dialog:

Follow these steps to open the Print dialog.

Step	Action
1	Select Menu **File**, **Print...**.
2	The **Print** dialog appears.
3	Change the printer settings as required.
4	Press the **OK** button or press the **Print button**  or press the keys **Ctrl+P**.

The graph or the report of the active pane will be printed with the selected printer settings.

Exit

Follow these steps to Exit.

Step	Action
1	Select Menu **File**, **Exit**.
2	The confirmation **GeoMoS Analyzer** dialog appears.
3	Press the **OK** button to confirm that the application should be closed. GeoMoS Analyzer will be closed and the current configuration settings (e.g. time range, point selection in the point view tree) will be saved.

Edit

Copy

The displayed graph or report can be copied to the clipboard.

To Copy:

- Selec t Menu **Edit**, **Copy...** or press the **Copy button** or press **Ctrl+C** on the keyboard.

The graph or report will be copied to the clipboard and can be copied afterwards from the clipboard with the keyboard commands Ctrl+V into another application (e.g. MS Word, MS Excel).

View

Refresh

- Select the menu **View**, **Refresh**, or press the toolbar **button Refresh** or press **F5**.

The system refreshes the report and the graphs based on the selected points and the defined time range. The graphs only show the valid results (based on the settings made in the report). The point tree view will not be updated. If new points, profiles, point groups, etc. have been added in the monitor application the Analyzer will not immediately show these points in the tree. It is necessary to restart the Analyzer application to update the tree view in the Analyzer application.

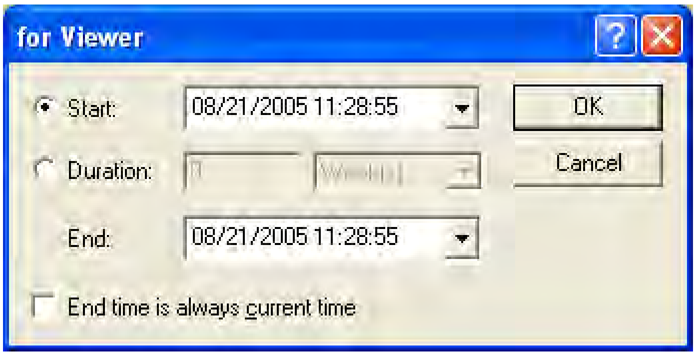
Set user display rights

Background information

The user 'Administrator' can set the display rights for the user 'Viewer'. The user 'Viewer' only has the rights to access the data between the time period defined by the 'Administrator'.

Procedure

Follow these steps to set the user display rights.

Step	Action
1	Select Menu **View**, **Set user display rights...**.
2	The **for Viewer** dialog appears. 
3	Select the option **Start** and enter the time and date for the beginning of the visible interval. or Select the option **Duration** and enter the duration of the visible interval.
4	Enter the end time and date for the End of the visible interval. With this field the end time of the visible interval can be fixed. or Select the option **End time is always current time**. This option is only active when the check box is checked. If this option is active, the end time of the visible interval is always taken as the current system time or the last stored record of the database. **There are different options to define the time range:**

	End: Current Time and fixed **Start** time **End time is always current time** and **Duration** Fixed **End** time and **Duration** Fixed **End** time and fixed **Start** time The system shows the graphs and report from the **end** time back to the start time. It is possible to define the end time via the **current system time** by checking the check box or by defining a fixed end time.
5	Press the **OK** Button. The user ’Administrator’ defines the display rights for the user ’Viewer’. After the user ’Administrator’ has defined the time range for the user ’Viewer’, the user ’Viewer’ can only select a time range within the range defined for the user ’Viewer’.

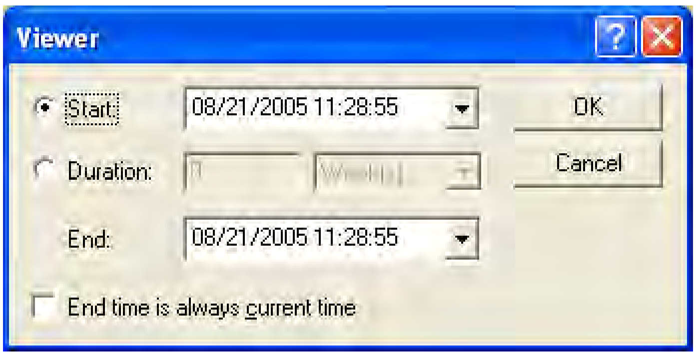
Time Period

Background information

The viewer can define the time period for all graphs, report and the contents of the Data Editor dialog.

Procedure

Follow these steps to configure the time period.

Step	Action
1	Select Menu **View**, **Time Period...** or press the toolbar **Time Period button** .
2	The **Time Period** dialog is displayed. 
3	Select the option **Start** and enter the time and date for the beginning of the required visible interval. or Select the option **Duration** and enter the duration of the required visible interval.
4	Enter the end time and date for the **End** of the required visible interval. With this field the end time of the visible interval can be fixed. or Select the option **End time is always current time**. This option is only active when the check box is checked. If this option is active, the end time of the visible interval is always taken as the current system time or the last stored record of the database.

	There are different options to define the time range: **End: Current Time** and fixed **Start** time **End time is always current time** and **Duration** Fixed **End** time and **Duration** Fixed **End** time and fixed **Start** time The system shows the graphs and report from the defined **End** time back to the Start time. It is possible to define the end time to use the **current system time** (checkmark active) or to define a fixed End time.
5	Press the **OK** button. The system stores the entered settings and closes the **Time Period** dialog. To show the graphs and the reports with the new time range press the button Refresh . The selected visible time range will be shown in the Status Bar.

Step mode

Background information

With the Step Mode it is possible to analyze the graphs/report of the shown points, profiles and the point groups of the tree view one by one. This option can be used to quickly show and check all graphs of all points separately. Use the cursor keys on the keyboard to navigate through the point tree. Only one node of the tree (point, profile, point group) can be selected at one time. The current selection will be shown in the graphs and reports.

Procedure

Follow these steps to use the Step mode.

Step	Action
1	Select the menu **View**, **Step Mode**, or press the **Single Mode button** .
2	The **Step Mode** is turned on or off. If the Step Mode is active a check mark will be shown next to the menu and the Step Mode button in the toolbar is pressed down. The main view shows the graph/report of the first selected point or profile of the point tree view. The graphs/report are always shown with the active settings of the graphic options and the selected time range.
3	Press the keyboard '**Cursor Down**' key, to show the graph of the next point in the point view tree. With the '**Cursor Up**' key it is possible to show the previous graph.

Navigating in the Point View Tree

To navigate in the point view tree it is necessary to click in the window. Use the cursor keys on the keyboard to navigate through the tree. The system navigates stepwise through all visible (open) nodes of the tree and shows the corresponding graphs in the main window.

Print

The Step Mode supports the same printing capabilities as the normal mode.

- Selec t Menu **File**, **Print**, or press the **button Print** , or press **Ctrl+P**.

Toolbar

- Selec t Menu **View**, **Toolbar**.

The Toolbar will be shown or hidden. A checkmark will be shown in the menu if the Toolbar is visible.

Status Bar

- Select from the menu **View**, **Status Bar**.

  Shows or hides the Status Bar. A check mark is shown next to the menu item when the Status Bar is visible.

Status Bar

Configuration

Comments Editor

Background information

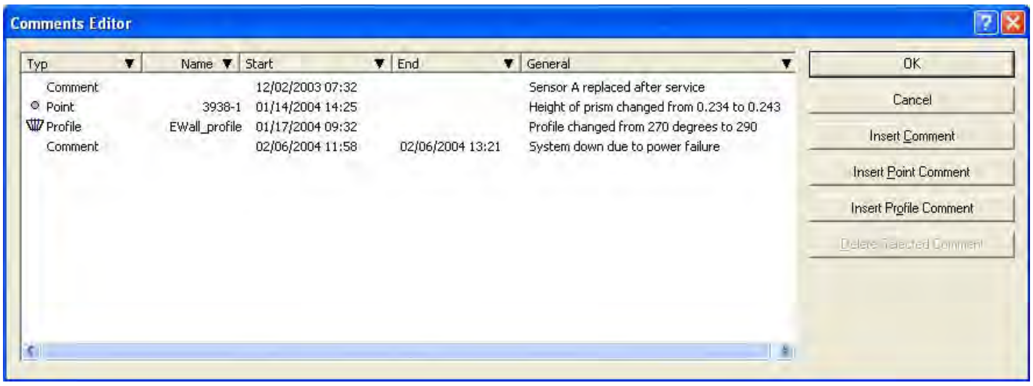
It is possible to define comments for points and profiles. These comments can be defined for a particular time or over a time period. The columns in the **Comments Editor** dialog can be sorted to make it easier to search for comments. The comments can be displayed chronologically in the displacement and velocity graphic.

Enter Comments

The Comments Editor dialog defines the comments for the points and profiles. If a new comment is added, a new line will be shown in the spreadsheet of the dialog. It is possible to select the **Point ID's** or **Profile names** in the spreadsheet. The **start date** will be initially set automatically based on the current date and time. Select the **end date** and enter a value to define the comment over a defined time period. The comment text can be edited in line. The Tab key moves from one column to the next.

Follow these steps to enter comments.

Step	Action
1	Select menu **Configuration**, **Comments Editor...** or press the **Comments button** .
2	The **Comments Editor** dialog will be displayed.
3	Add a comment or edit an existing comment.
4	Press the **OK** button. The **Comments Editor** dialog will be closed and the new and modifications will be stored in the database.



The table below describes the fields and buttons in the Comments Editor dialog box.

Field/Button	**Description**
Type	Indicates via Comment, Point or Profile the type of the comment.
Name	Lists the point name or profile name in case of a point of profile comment.
Start	Defines the time when the comment begins.
End	Defines the time when the comment ends.
General	Shows the text of the comment.

Insert Comment	Adds a new general comment.
Insert Point Comment	Adds a new comment specifically related to a chosen point.
Insert Profile Comment	Adds a new comment specifically related to a chosen profile.
Delete Selected Comment	Deletes a comment.

To Edit comments

To edit a comment, double click in the comment field to modify a comment. Press the enter button to finish editing. Every field is editable.

Comment Filter

Each column of the dialog can be filtered. Click on the black arrow in the header of the column you want to filter. The **Show All** option shows all comments without filtering. Select **individual** to make a query with a maximum of two conditions. You can select the filters out of the lists &endash; the comments will be shown defined by the selected options.

Sorting

It is possible to sort the columns ascending or descending. It is also possible to hide and show the different columns, by pressing the right mouse button on the column header to select a option.

Print Comments

Follow these steps to print comments.

Step	Action
1	Press the right mouse button in the spreadsheet and select **Print...** from the right mouse menu.
2	The **Print** dialog appears.
3	Change the print settings as required.
4	Press the **OK** button.

The dialog will be closed and the printing will be started.

Comments in the Graphic

The comments can be displayed in the displacement and velocity graphics.

Follow these steps to configure comments in the graphics.

Step	Action
1	Select the menu **Configuration**, **Options...**.
2	The **Options** dialog appears.
3	Select the type of comments to display in the graphics.

4	Press the **OK** button. The dialog will be closed and the settings will be stored.
5	Select the menu **View**, **Refresh** to show the redraw the graphics with the new options you selected.
6	The comments can be shown or hidden in the graph. Press the **Tools** button  and select **Values legend**.

It is possible to display up to **10 comments**. If points with a profile have been selected, the comments of the profile will also be displayed. The comment indexes will be displayed in a separate legend. The start and end time of a comment will be shown by 2 different symbols in the graphic. If the start and/or end date is not in the visible area of the graphic, the comments will not be displayed.

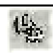
Note:

Comments are not displayed in the vector graph and will also not be exported in the DXN export.

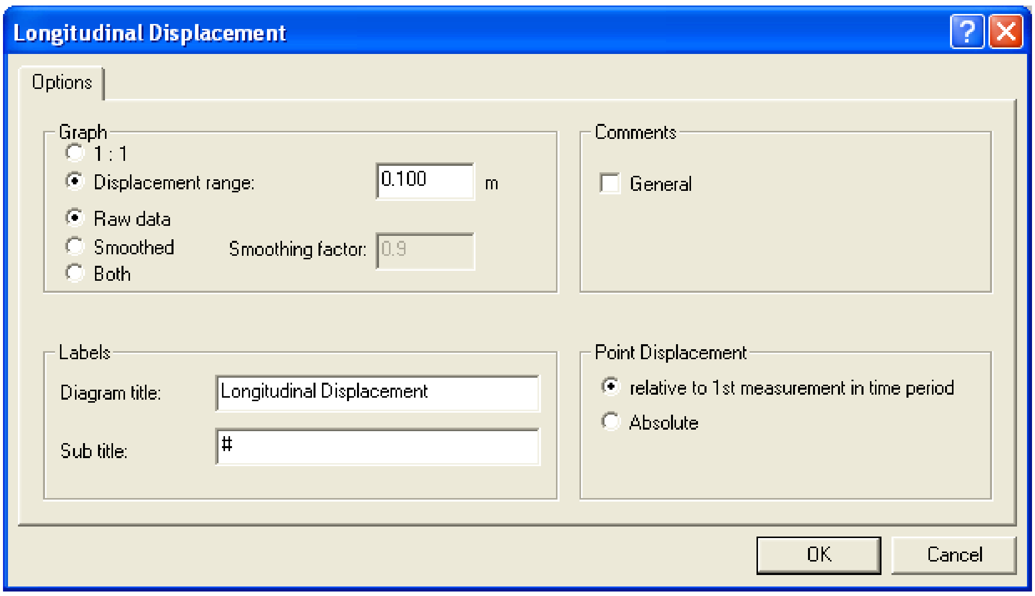
Graphic Options

Displacements - Longitudinal, Transverse and Height

Follow these steps to open and configure the Displacements dialog.

Step	Action
1	Select menu **Configuration**, **Graphic Options...** or press the button **Options** .
2	The **Graphic Options** dialog appears. The dialog shows option pages for the available graphics.
3	Activate the page **Displacement**, **Height** or **Transverse Displacement**. Define the right options.
4	Press the **OK** button.
5	Press refresh to show the Longitudinal, Transverse or Height Displacement graphic with the new options. The dialog will be closed and the new options will be stored.

The displacement page is defined by five main groups, Graph, Labels, Comments, Point Displacement and Absolute Limit Levels.



The table below describes the fields in the Options: Displacement tab dialog box.

Field	Description
Graph	There are two options available to show the displacement graphic: ▪ 1:1 ▪ Displacement Range The option **1:1** shows the displacement 1:1 on the screen based on the selected printer. The graphic will be enlarged by the system if the displacements of the selected time range are bigger than possible to display. The **displacement** range defines the range of the Y axis. If the displacement vectors of the selected time range do not fit into this Y-axis range, the system does not automatically enlarges the Y-axis range to the maximum value of the displacement vectors. The scale of the graphic is not modifiable and will be set by the system dependant on the selected options and time range. The graphic can be shown **Raw data**, **Smoothed** or **Both** graphs of the selected points. It is possible to enter a Smoothing factor. The smoothing factor can only be entered if the smoothed option is active. **Note:** The Fritsch-Carlson interpolation mathematics is used to smooth the curves. The Fritsch-Carlson interpolation produces a neat monotone piecewise cubic curve, which is especially suited for the presentation of scientific data. References: F.N.Fritsch, R.E.Carlson, Monotone Piecewise Cubic Interpolation, SIAM J. Numer. Anal. Vol 17, No. 2, April 1980. The displayed measurements of two subsequent points will be connected with a line if the time difference is less than a day. This option can be changed in the Graphics.ini file. [TimeLine_Options] MaxDiffDays=1.00000000

Labels	The diagram labels **Diagram title** and **Sub title** can be entered. Entering the <#> character shows the default subtitle in the diagrams. The print out

	shows the diagram creation date and time, date of the last measurement, X- and Y-axis, axis label and a point legend.

Comments	The comments can be displayed in the graphic. The comments can be entered in a separate dialog.

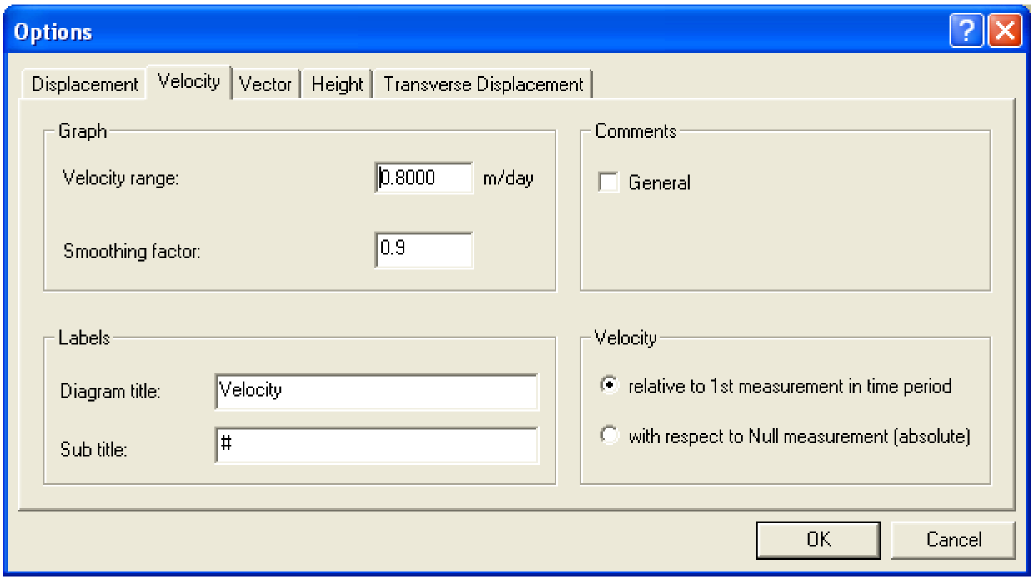
Point Displacement	The point displacement can be defined **relative** to the 1st measurement in time period or **Absolute** with respect to the Null measurement. The null-measurement is the first defined measurement. The relative option shows the graph beginning on the 0 value of the Y-axis. The displacements will be calculated relative to the first measurement of the selected time range. The absolute option shows the first point of the line with the absolute displacement value compared to the null measurements (e.g. -0.320 meters).
Absolute Limit Levels	The defined limit classes can be selected to be viewed in the longitudinal, transverse and height displacements tabs. **Note**: The option to view limit levels is only available if the point displacement is set to **Absolute**.

Velocity

Follow these steps to open and configure the Velocity dialog.

Step	Action
1	Select menu **Configuration**, **Options...** or press the button **Options** .
2	The **Graphic** Options dialog appears. The dialog shows option pages for the available graphics.
3	Activate the page **Velocity**. Define the required options.
4	Press the **OK** button.
5	Press refresh to show the Velocity graphic with the new options. The dialog will be closed and the new options will be stored.

The velocity page is defined by four main groups: Graph, Labels, Comments and Velocity.



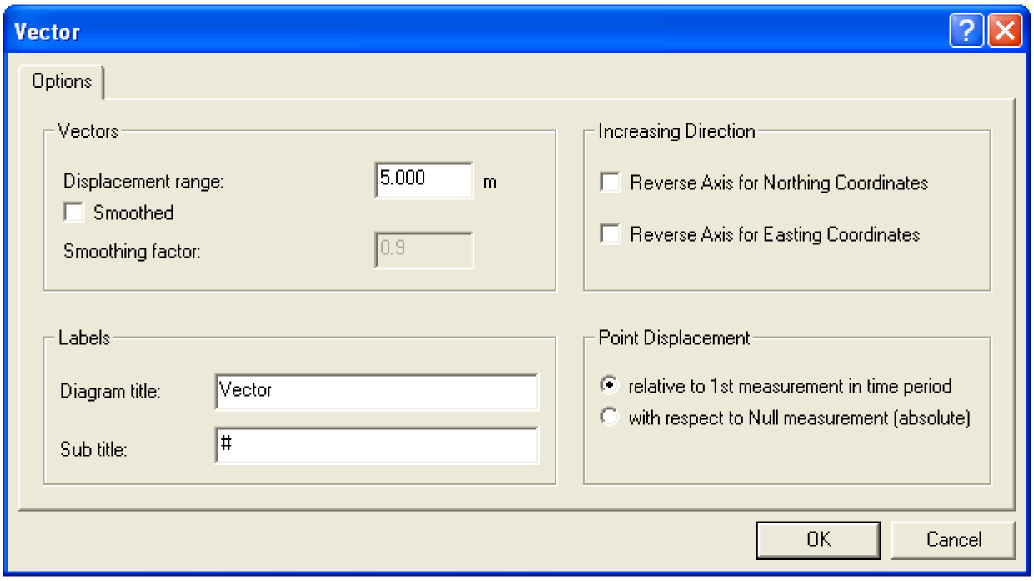
The table below describes the fields in the Options: Velocity tab dialog box.

Field	Description
Graph	To display the velocity graph it is necessary to define a **velocity range** in **displacement/day**. The defined value will be shown on the Y axis. The scale for the time axis is defined by the system based on the settings of the **Time Period** dialog. This graphic shows only **smoothed curves**. The smooth factor can be defined by the **Smoothing factor**.
Labels	The diagram labels **Diagram title** and **Sub title** can be entered. Entering the <#> character shows the default sub title in the diagrams. The print out shows the diagram creation date and time, date of the last measurement, X- and Y-axis, axis label and a point legend.
Comments	The comments can be displayed in the graphic. The comments can be entered in a separate dialog.
Velocity	The velocity can be defined **relative** to the 1st measurement in time period or **with respect** to the Null measurement. The Null measurement is the first defined measurement. The relative option shows the graph beginning on the 0 value of the Y-axis. The velocity will be calculated relative to the first measurement of the selected time range. With respect to the Null measurement option shows the velocity compared to the smallest absolute velocity value (e.g. 0.01 m/day).

Vector

Follow these steps to open and configure the Vector dialog.

Step	Action
1	Select menu **Configuration**, **Options...** or press the button **Options** .
2	The **Options** dialog appears. The dialog contains three pages, each of the page contains the options for the graphics.
3	Select the page **Vector**. The vector option page is divided in the following three parts: Vector, Labels and Point displacement. Choose the required options in this page.
4	Press the **OK** button to accept the settings.
5	Press refresh to show the Vector or Height Vector graphic with the new options. The dialog will be closed and the new options will be stored.



The table below describes the fields in the Options: Vector tab dialog box.

Field	Description
Vectors	The point movements (displacement vector) will be defined by the **displacement range**. The length of the vector is based on a fixed value (e.g.: 1 cm on a print out). If the vectors are to long and lay on top of each other it is necessary to increase the displacement range value. The

	displacement vectors will be drawn in the right position and direction and the length is based on the selected profile. The two axis show the coordinates of the selected coordinate system. The horizontal axis shows the Easting (Y) and the vertical axis shows the Northing (X).

Labels	The diagram labels **Diagram title** and **Sub title** can be entered. Entering the <#> character shows the default subtitle in the diagrams. The print out shows the diagram creation date and time, date of the last measurement, X- and Y-axis, axis label and point legend.

Increasing Direction	Check or uncheck to reverse the displayed axis for either the Northing and/or Easting coordinates.

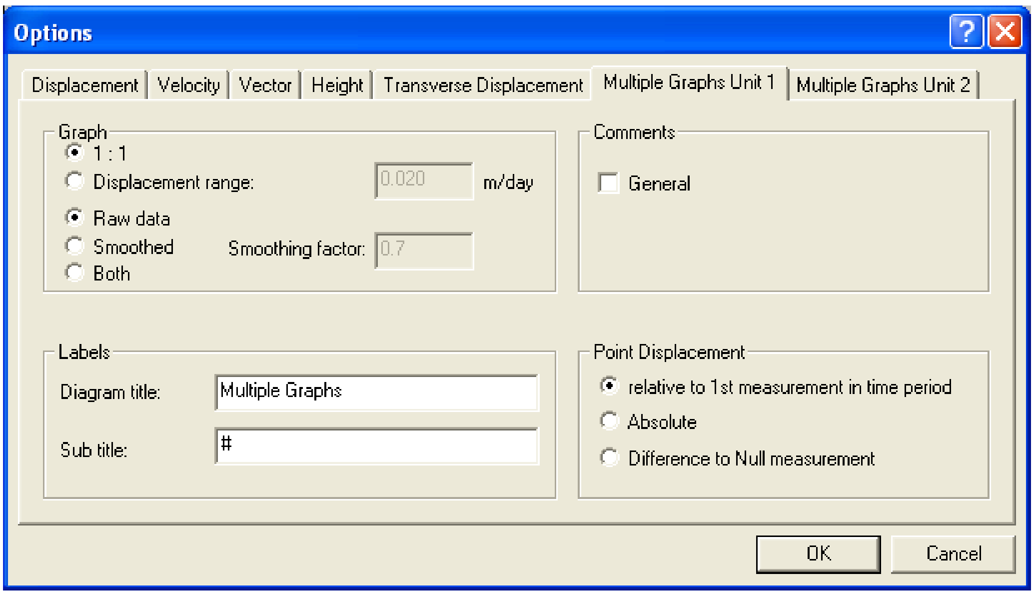
Point Displacement	The displacement vector can be defined **relative** to the 1st measurement in time period or **with respect** to the Null measurement. The null-measurement is the first defined measurement.

Multiple Series

Follow these steps to open and configure the Multiple series dialog.

Step	Action
1	Select menu **Configuration**, **Options...** or press the button **Options** .
2	The **Graphic Options** dialog appears. The dialog shows option pages for the available graphics.
3	Activate the page **Multiple Series 1** or **Multiple Series 2**. Define the right options.
4	Press the **OK** button.
5	Press refresh to show the Multiple Graphs with the new options. The dialog will be closed and the new options will be stored.

The multiple graphs page is defined by four main groups, Graph, Labels, Comments and Point Displacement.



The table below describes the fields in the Options: Multiple Graphs Unit 1 and Unit 2 tab dialog box.

Field	Description

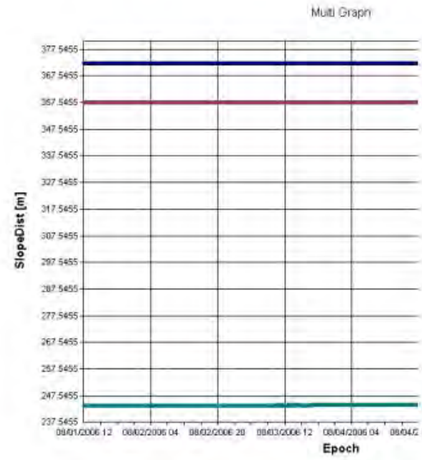
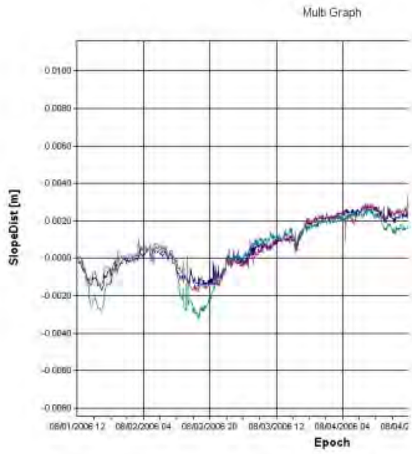
Graph	There are two options available to show the displacement graphic: ▪ 1:1 ▪ Displa cement Range The option **1:1** shows the displacement 1:1 on the screen based on the selected printer. The graphic will be enlarged by the system if the displacements of the selected time range are bigger than possible to display. The **displacement** range defines the range of the Y axis. If the displacement vectors of the selected time range do not fit into this Y-axis range, the system does not automatically enlarges the Y-axis range to the maximum value of the displacement vectors. The scale of the graphic is not modifiable and will be set by the system dependant on the selected options and time range. The graphic can be shown **Raw data**, **Smoothed** or **Both** graphs of the selected points. It is possible to enter a Smoothing factor. The smoothing factor can only be entered if the smoothed option is active. **Note:** The Fritsch-Carlson interpolation mathematics is used to smooth the curves. The Fritsch-Carlson interpolation produces a neat monotone piecewise cubic curve, which is especially suited for the presentation of scientific data.References: F.N.Fritsch, R.E.Carlson, Monotone Piecewise Cubic Interpolation, SIAM J. Numer. Anal. Vol 17, No. 2, April 1980.

Labels	The diagram labels **Diagram title** and **Sub title** can be entered. Entering the <#> character shows the default subtitle in the diagrams. The print out shows the diagram creation date and time, date of the last measurement, X- and Y-axis, axis label and a point legend. The labels can only be entered on the **Multiple Series 1** tab.

Comments	The comments can be displayed in the graphic. The comments can be entered in a separate dialog. The checkbox on the **Multiple Series 1** tab activates the

	comments.

Point Displacement	The point displacement can be defined ▪ **relative** to the 1st measurement in time period ▪ **absolute** or ▪ with **difference** to the null measurement. The relative option shows the graph beginning on the 0 value of the Y-axis. The displacements will be calculated relative to the first measurement of the selected time range. The absolute option shows the graph with the absolute values (e.g. Slope Distance = 934.45 meters) The difference option shows the graph with the absolute displacement value compared to the null measurements (e.g. -0.320 meters). The null-measurement is either defined in the Null Measurement Editor (geotechnical sensors) or in the Point Editor (geodetic sensors with coordinates). **Important:** The option with **difference to the null measurement** is **not available** for the series Hz Angle, Corrected Hz Angle, V Angle, Corrected V Angle, Slope Distance, Corrected Slope Distance (Atmos PPM), Corrected Slope Distance (Ref PPM), Orientation, Vz correction, Atmos Correction and Ref PPM Correction. If selected the graph is displayed as **absolute** graph. **Hint:** If you display multiple points and the option **absolute** is selected together with an absolute series, for example Slope Distance, the absolute values are displayed. To interpret the graphics more powerfully it may help to display absolute series **relative** to the 1st measurement in time period.

	Multi Graph SlopeDist [m] 377.5455 367.5455 357.5455 347.5455 337.5455 327.5455 317.5455 307.5455 297.5455 287.5455 277.5455 267.5455 257.5455 247.5455 237.5455 08/01/2006 12 08/02/2006 04 08/02/2006 20 08/03/2006 12 08/04/2006 04 Epoch Multi Graph SlopeDist [m] 0.0100 0.0080 0.0060 0.0040 0.0020 0.0000 -0.0020 -0.0040 08/01/2006 12 08/02/2006 04 08/02/2006 20 08/03/2006 12 08/04/2006 04 Epoch

Daily Average

Background information

GeoMoS Analyzer has an option to display the result data as daily average. The daily average is calculated from 00:00 hr to 24:00 hrs for any particular day. The main purpose is to reduce the amount of data viewed in the graphics over longer time periods (e.g. weeks, months or years). It is sometimes easier to see the trends of the graphics over longer periods when the data is filtered and reduced using the daily average calculation.

If the daily average is active the measurements from the last 24 hours will be displayed as raw measurements.

- Select the menu **Configuration**, **Daily Average**.

  Note:

  To de-activate the Daily Average display mode select the **Configuration** menu **Daily Average** again.

Automatic Calculation of Daily Average

To view the Daily Average in Analyzer, the average results must first be calculated. Select the menu **Configuration**, **Daily Average** in the GeoMoS **Monitor** program for the automatic calculating of the daily average.

Manual Calculation of Daily Average

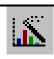
To view the Daily Average in Analyzer, the average results must first be calculated. Select the menu **Configuration**, **Daily Average** in the GeoMoS **Monitor** program for manual calculating of the daily average.

Note:

- The Daily Average only calculates the average of the results. The average is calculated and stored as an average result (the measurement is not averaged). This means that in the Analyzer Report the Daily Average display will not display measurement values (ie. Hz angle, Vz angle, Slope Distance, etc.) in the report table.

Create Color Palette

Follow these steps to create Color Palette.

Step	Action
1	Select from the menu **Configuration**, **Create Color Palette...**.
2	The **Create Color Palette** dialog appears. 
3	Enter a **Name** for the new color palette.
4	Press **OK** to confirm of **Cancel** to abort the function.
5	The new color palette must be activated in the **Chart FX Properites** dialog. The **Chart FX Properites** dialog show all possibilities for customizing the graphics.
6	Select from the **Graphic toolbar** the  button or right click and select from the context menu the **Properties** menu.
7	The **Chart FX Properites** dialog appears. Edit the new color palette to your needs.
8	Press **OK** to confirm of **Cancel** to abort the function.

Background Map

Background information

The geo-referencing component enables you to manage background images for use within the Site Map. A referenced image is attached to a project and can appear as background image in the Site Map. Background images support you in identifying the location of monitoring points in a map and navigation to the corresponding time line diagrams.

Procedure

Follow these steps to load and configure a background map.

Step	Action
1	Open the Background Map dialog
2	Assign a background image
3	Reference a background image

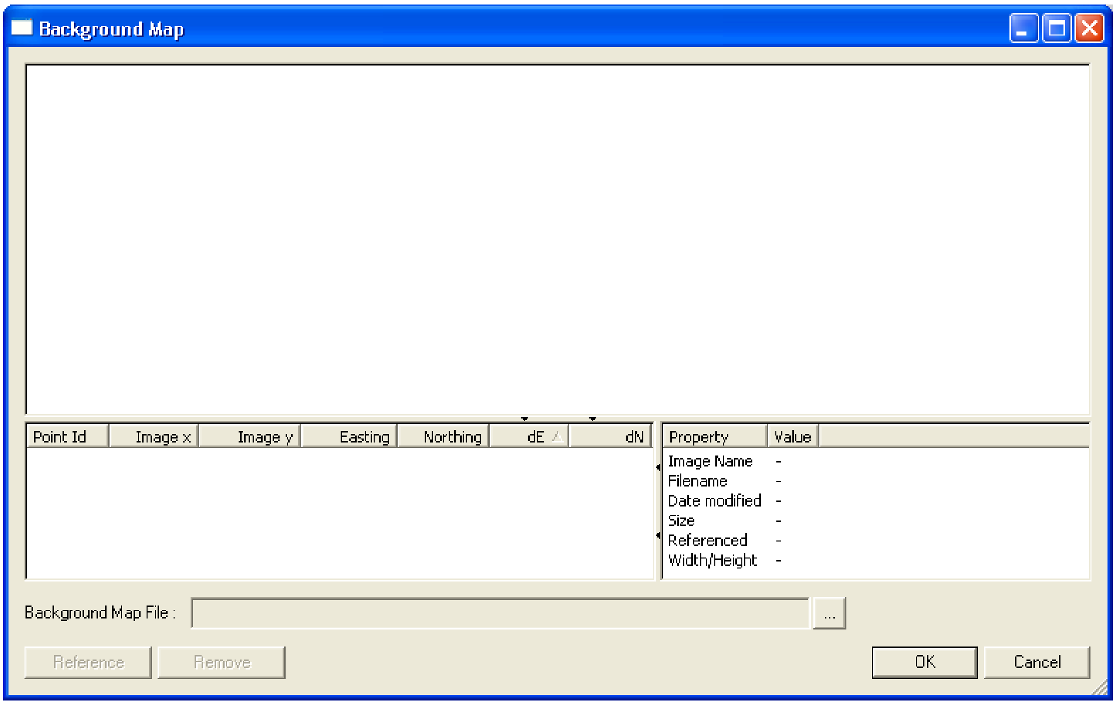
See also:

- Edit / Delete common reference points
- Background Map properties
- Tips

Step 1: Open the Background Map dialog

Follow these steps to open the Background Map.

Step	Action
1	Select from the menu **Configuration**, **Background Map...** .
2	The **Background Map** dialog is displayed.

	 **Note:** Each field of the Background map dialog is explained in detail below. Click on the image or see Background Map properties.
3	Continue to Step 2: Assign a background image.

Step 2: Assign a background image

Before you can start referencing a background image in GeoMoS you have to register the image.

- Only one image can be registered for one project at any one time.
- The following graphic files are supported: *.bmp, *.jpg, *.jpeg, and *.gif.

Follow these steps to assign a background image.

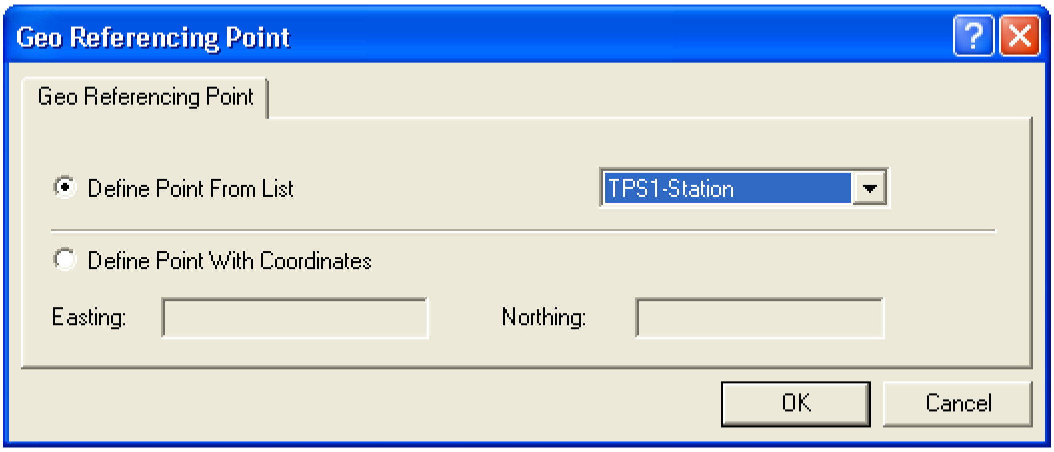
Step	Action
1	Load a **Background Map File** by pressing the **Browse** button.
2	The **Register Image** dialog is displayed.
3	Browse to the location where you have stored your background images. By default **All supported graphic file** types found in the selected location will be listed for

	selection.
4	Select an image and press the **OK** button to add the image to the current GeoMoS project and save it in the database.
5	Continue to Step 3: Reference a background image.

Step 3: Reference a background image

To reference an image the local grid coordinates of the image points have to be known so that points can be matched. Once the points have been matched the image can be oriented, i.e. referenced to the local grid.

Follow these steps to reference a background image and match common points.

Step	Action
1	To identify a point in the background image zoom into the area of the image where the common point is located.
2	When you have identified the point **double-click** onto it or select **Set Reference Point** from the context menu to insert it into the image. A little cross indicates the location of the point.
3	The **Geo Referencing Point** dialog appears. 
4	You can either define a point from the existing point coordinates or enter the Easting or Northing of each common point manually.
5	The image coordinates and the local grid coordinates of the point are matched.
6	When you have identified all common points proceed with the **Reference** button. The image will be oriented according to the local grid.

	Note: The more common points you have the better image distortions can be accounted for. You need to define at least two reference points.
7	Referenced images are indicated with the following icon:  in the upper right corner of the view. In the lower right window the status of the image changes from **unreferenced** to **referenced**.
8	After an image has been referenced you can view the residuals of the transformation from image coordinates to grid coordinates in the lower left window.
9	Confirm the transformation between image coordinates and local grid coordinates with **OK**.
10	The dialog will be closed and the transformation will be saved in the database.

Edit / Delete common reference points

Any of the geo-referenced points can be deleted or edited if the background image is not referenced.

- To **delete** points from the image either select a point in the image or select the point(s) to be deleted in the corresponding lower left window. Choose **Delete** from the context menu to delete the selected point(s).
- To **modify** the point, select in the lower left window **Modify** from the context menu. The referencing information can now be edited.
- In edit mode the point on the map image cannot be moved, only the true coordinate values or image pixel values can be changed. If you wish to change the position of the referencing point on the map, you must first delete the incorrect point and create a new one.

Background Map properties

The table below describes the fields and buttons in the Background Map dialog box.

<table>
<tr><th>Field/Button</th><th>Description</th></tr>
<tr><td>Main window</td><td>Contains the map image. Right click in this window pane and the following context menu is displayed.
<table>
<tr><th>Menu item</th><th>Description</th></tr>
<tr><td>Set reference point</td><td>You can define the coordinates for a reference point by right-clicking on the desired location in the map.</td></tr>
<tr><td>Delete points</td><td>Select a defined referenced point and right-click on it to delete it.</td></tr>
<tr><td>Zoom in, out, 100%</td><td>Zoom in or out within the map displayed.</td></tr>
<tr><td>Color Contrast</td><td>Controls the intensity of color for the background map. This adjustment is directly connected to the Color contrast adjustment in the Graphical Settings dialog.</td></tr>
<tr><td>View Point ID</td><td>When checked the 4 character site code is displayed in the map.</td></tr>
</table>
</td></tr>
</table>

Lower right window	Displays information about the file being used for the background map.
Image Name	Taken from the file name.
File name	File name and path of displayed map.
Size	Size of displayed map file in KB.
Referenced	Yes or No is shown.
Width/Height	Size of the displayed map in Pixels.
Lower left window	Contains a report view listing all the points which have been identified as common points in the image.
Point ID	The point name or an integer number.
Image x	Position in pixels starting at upper left corner of the image.
Image y	Position in pixels starting at upper left corner of the image.
Easting	As entered

Northing	As entered

Background Map File	The selected Background map file.
	When you have identified all common points, press the **Reference** button to reference the background image.
Remove	Press this button to delete the selected background image.

Tips

- In colorful images it might be advisable to blend the image to achieve a better contrast of the identical points to their background image. Select **Color Contrast** from the context menu. This functionality is also available from **Graphical Settings** dialog to achieve a better contrast of the representation of points to the attached background image.

Post Processing

Background information

The post processing functionality is license protected. This functionality can be purchased with GeoMoS Analyzer Option 1 (article number 774 138). Please contact your Leica representative.

The post processing re-computes the data over the effected time period. All data between the period of the earliest edited data and the latest edited data will be post processed. The data will be processed according to the options selected in the **Post Processing** dialog (e.g. Type of Meteo Model). When the **Process** button is pressed the data will be saved and post processed. The original results will be overwritten with the new computed results and stored in the database. It is recommended to back up the database before doing post processing. This is especially so when you are not experienced or a complicated reprocessing may be done (e.g. to correct the effects of an unstable reference point).

The time period for the post processing is dependent on the time of the measured data that was edited. It is possible that the measured data that is edited, can effect other data outside the selected time period. In this case, it is possible that the post processing processes data that is before or after the selected time period. This must be done to keep the data and computations consistent.

Open and use the Post Processing dialog

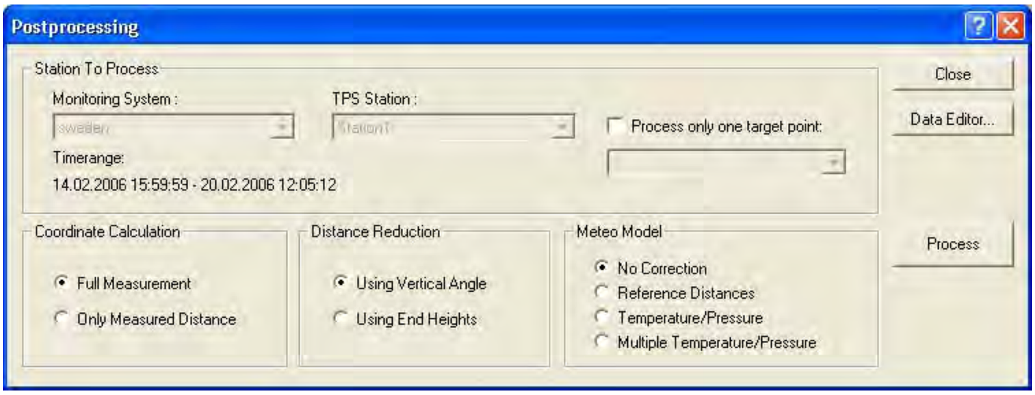
Follow these steps to open and use the Post Processing dialog.

Step	Action
1	Select the menu **Configuration**, **Post Processing....**
2	The **Post processing** dialog will be displayed.
3	Select a **total station** control point from the list. This is the Total Station coordinate that will be post processed. Only data from this station will be shown in the **Data Editor**. **Note:** Only one instrument station can be processed at a time.
4	Activate the checkbox if you want to **Process only one target point**. Only data form this point will be shown in the **Data Editor**.

5	Select the **Coordinate Calculation** options used for the post processing.
6	Select the **Distance Reduction** options used for the post processing.
7	Select the type of **Meteo Model** used for the post processing options.
8	Edit the existing data with the **Data Editor** button as required.
9	Start the post processing with the **Process** button. The new computed results and all modified data will be stored in the database. **Notes:** ▪ The original data can only be restored by re-entering the original values. There is **no UNDO** functionality for post processing! ▪ Depending on the amount of data in the database it may take some minutes for the Data Editor to load.
10	Click the **Close** button. The **Post Processing** dialog will be closed. As long the **Process** button has not been pressed the data will not be stored in the database and it is possible to abort the dialog with the **Close** button.

Note: The above description guided you through the post processing by describing the minimum settings only.

Post Processing Properties



The table below describes the fields and buttons in the Postprocessing dialog box.

Field/Button	Description
Station to Process	Horizontal angles, vertical angles and slope distances are measured from a total station. If you are use more than one total station in your monitoring project it is required that the correct station is selected.
Coordinate Calculation	The coordinate calculation is set as default to the identical coordinate calculation method as used in the Monitor application. The coordinate calculation is either **Full Measurement** (recommended) or **Only Measured Distance**. ▪ Full Measurement: All angle and distance measurements are used to calculate the target point coordinates. ▪ Only Measured Distance: This is a special computation technique that uses only the measured distance to calculate the target point coordinates.
Distance Reduction	The reduction of the distance to horizontal can be selected to use the measured **vertical angle** (recommended) or the **end heights** (i.e. elevations) of the Total Station control point and target points.
Meteo Model	The meteorological data is measured at regular interval and stored in the database with a time stamp. The time period for the display of the meteorological data is set in the **Time Period** dialog. The meteorological data is displayed according to the defined time period. **Temperature/Pressure** Meteo Model options are dependent on the availability of meteorological measurements of temperature and pressure in the database. If no meteo data is available in the database this selection may produce invalid results. The use of **Reference Distances** model requires that at least one PPM group is defined for the measurement cycle. The current PPM group defines the reference points that will be used for the Reference Distance PPM calculation. The points in the current PPM group will be shown in the

	Data Editor.

Close	The **Post Processing** dialog will be closed. As long the **Process** button has not been pressed the data will not be stored in the database and it is possible to abort the dialog with the **Close** button.
Data Editor...	For more information on the Data Editor see the following topics. Data Editor Overview Data Editor: Additive Constant/Reflector Height Data Editor: Meteo Data Editor: Setups Data Editor: Reference Point Coordinates Data Editor: Manual Coordinates
Process	The **Process** button re-computes the data over the effected time period. All data between the period of the earliest edited data and the latest edited data will be post processed. The data will be processed according to the options selected in the **Post Processing** dialog (e.g. Type of Meteo Model). The original results will be overwritten with the new computed results and stored in the database. A process bar indicates the post processing. The new computed results and all modified data will be stored in the database.

Important:

If you need further help about post processing and the integrated post processing possibilities please contact your support team.

Data Editor

Data Editor - Overview

Click on each tab to learn more about the Data Editor.

Data Editor: Additive Constant/Reflector Height

Background information

The additive constant shows the prism constant used for the measurements. The additive constant can be defined in the **Point Editor** dialog in the Monitor application. The additive constant used for a measurement is copied from the additive constant assigned to the point at the time of the measurement. The additive constant value for the measurement can be changed in the **Data Editor** dialog of the Analyzer application and the measurements can be reprocessed.

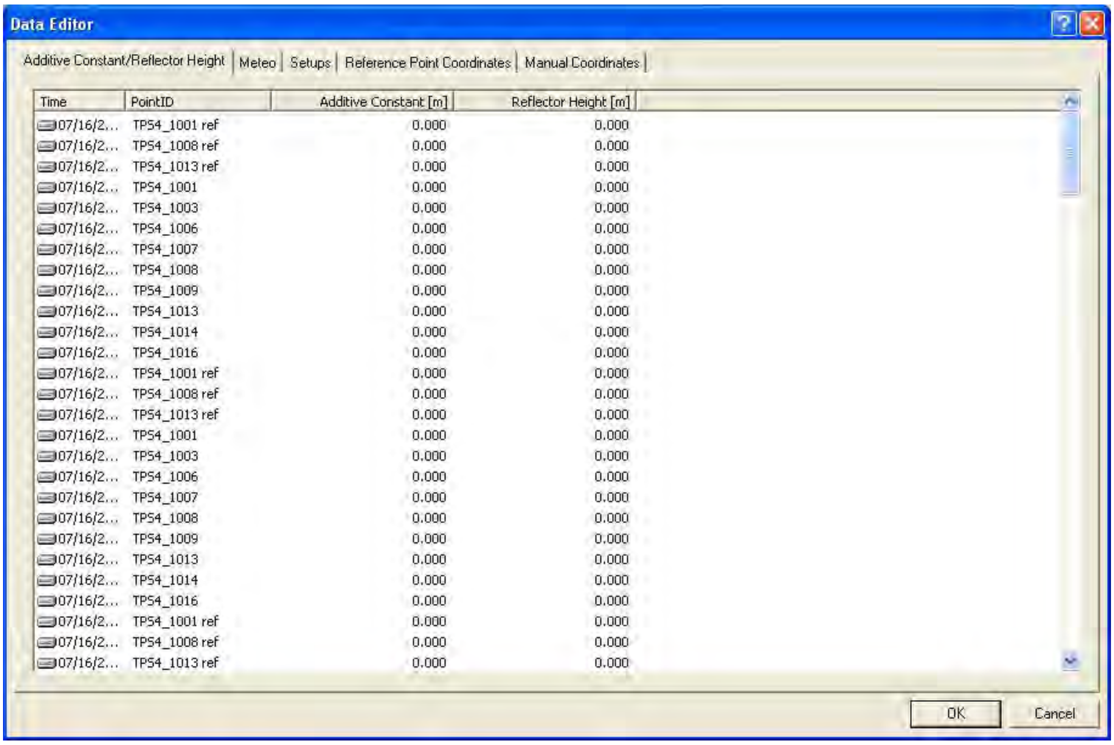
The additive constant shown in the **Data Editor** represents the additive constant of the measurement. Every line in the **Data Editor** represents a measurement. Editing the measurement additive constant has no effect on the additive constant of the point in the **Point Editor** dialog.

The reflector height shows the prism height used for the measurements. The reflector height can be defined in the **Point Editor** dialog in the Monitor application. The reflector height used for a measurement is copied from the reflector height assigned to the point at the time of the measurement. The reflector height value for the measurement can be changed in the **Data Editor** dialog of the Analyzer application and the measurements can be reprocessed.

The reflector height shown in the Data Editor represents the reflector height of the measurement. Every line in the Data Editor represents a measurement. Editing the measurement reflector height has no effect on the reflector height of the point in the **Point Editor** dialog.

The **ID** (Point Identifier) and **Time** columns cannot be edited. Only the **Additive Constant** and **Reflector Height** column can be edited. Only existing values can be modified. Additional records cannot be created.

Additive Constant/Reflector Height Properties



The table below describes the fields in the Additive Constant/Reflector Height tab.

Field	Description
Type	This column displays an icon symbol for the type of edited point.  Original point value  Edited point value
Time	The date and time the point was measured.
Point ID	The Point ID defined in the Point Editor dialog.
Additive Const	The used additive constant.
Reflector Height	The used reflector height.

OK	The Data Editor dialog will be closed and the data changes will be stored in the database.
Cancel	The Data Editor dialog will be closed and the data changes will not be stored in the database.

Further information

Data Editor Overview

Data Editor: Meteo

Data Editor: Setups

Data Editor: Reference Point Coordinates

Data Editor: Manual Coordinates

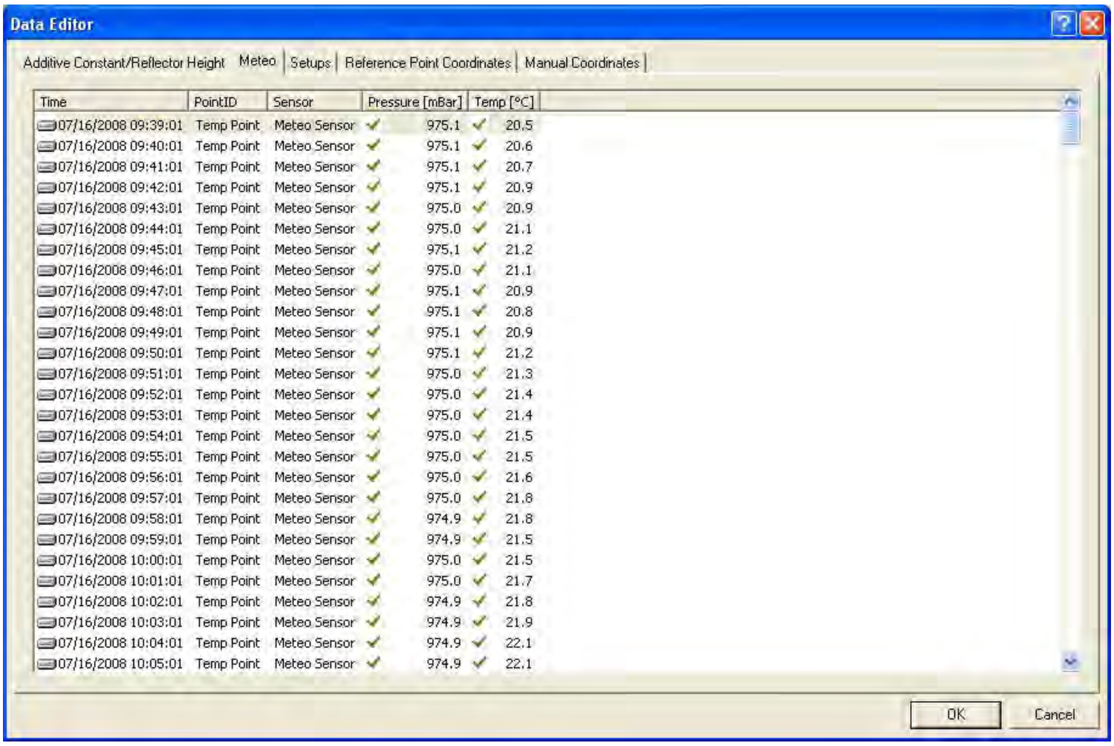
Data Editor: Meteo

Background information

The table shows all collected meteorological data of the defined time period. The meteorological data can be edited.

It is not possible to modify the **Point ID** and the **Time**. Adding new lines (additional measurements) is not possible.

Meteo Properties



The table below describes the fields in the Meteo tab.

Field	Description
Time	The date and time the pressure / temperature was measured.
Point ID	This column displays the Point ID on which the meteo sensor located.
Sensor	The sensor name that is used for the pressure / temperature measurement.
Pressure	The measured pressure.
Temperature	The measured temperature.

OK	The Data Editor dialog will be closed and the data changes will be stored in the database.
Cancel	The Data Editor dialog will be closed and the data changes will not be stored in the database.

Further information

Data Editor Overview

Data Editor: Additive Constant/Reflector Height

Data Editor: Setups

Data Editor: Reference Point Coordinates

Data Editor: Manual Coordinates

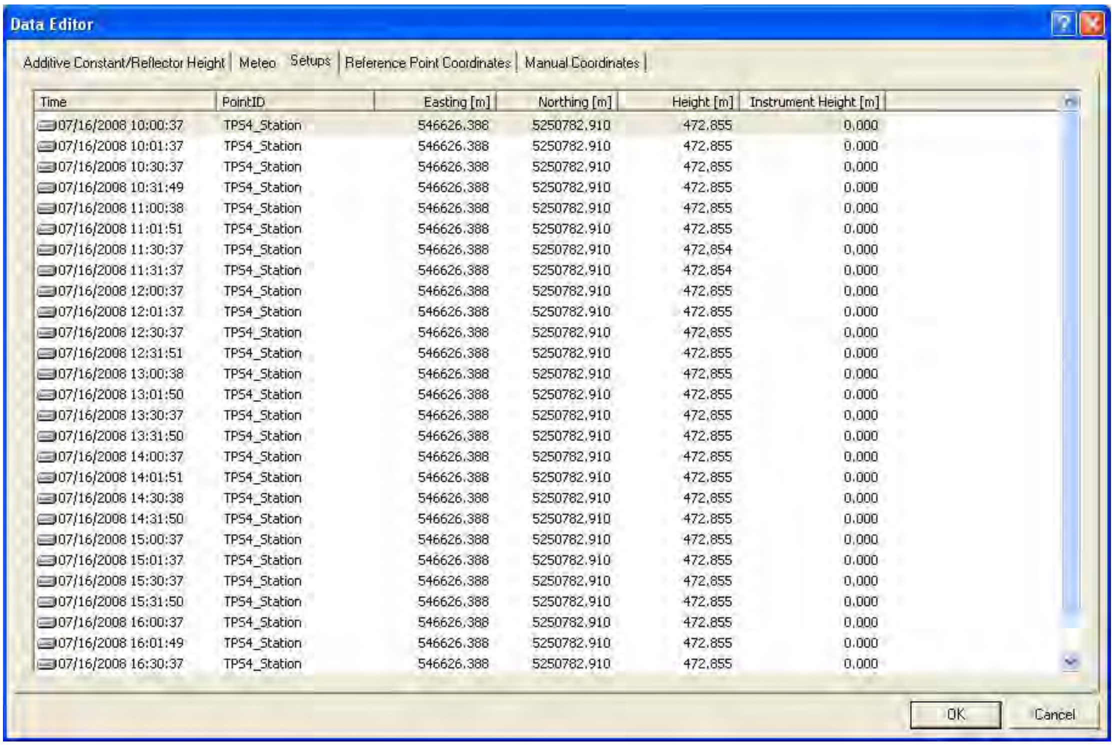
Data Editor: Setups

Background information

The Total Station coordinates are calculated in the automatic measurement cycle at the beginning of a point group of type "Normal" or after a point determining point group (free station, distance intersection or GNSS update). The coordinates in the automatic cycle are calculated over a defined time defined in the **TPS Properties** dialog using Free Station computation, Distance Intersection computation or GNSS coordinates. The manual method of determining the control point coordinates offers 4 different computation methods, being: manual control point setup, free station, distance intersection and GNSS coordinates. Post processing only uses the calculated coordinates of the control point. The control point coordinates can be edited manually and post-processed, but the control point coordinates are not reprocessed automatically by post processing.

The history of all control point coordinates will be displayed. It is not possible to modify the **Point ID** and the **Time**. The **Easting**, **Northing** and **Height** values can be modified. Adding new lines (i.e. additional control point coordinates) is not supported.

Setup Properties



The table below describes the fields in the Setups tab.

Field	Description
Type	This column displays a icon symbol for the type of edited point and the unique point ID.  Original point value  Edited point value
Time	The date and time the control point was measured.
Point ID	The Point ID defined in the Point Editor dialog.
Easting	The computed easting value.
Northing	The computed northing value.
Height	The computed height value.
Instrument Height	The used instrument height.
OK	The Data Editor dialog will be closed and the data changes will be stored in the database.
Cancel	The Data Editor dialog will be closed and the data changes will not be stored in the database.

Further information

Data Editor Overview

Data Editor: Additive Constant/Reflector Height

Data Editor: Meteo

Data Editor: Reference Point Coordinates

Data Editor: Manual Coordinates

Data Editor: Reference Point Coordinates

Background information

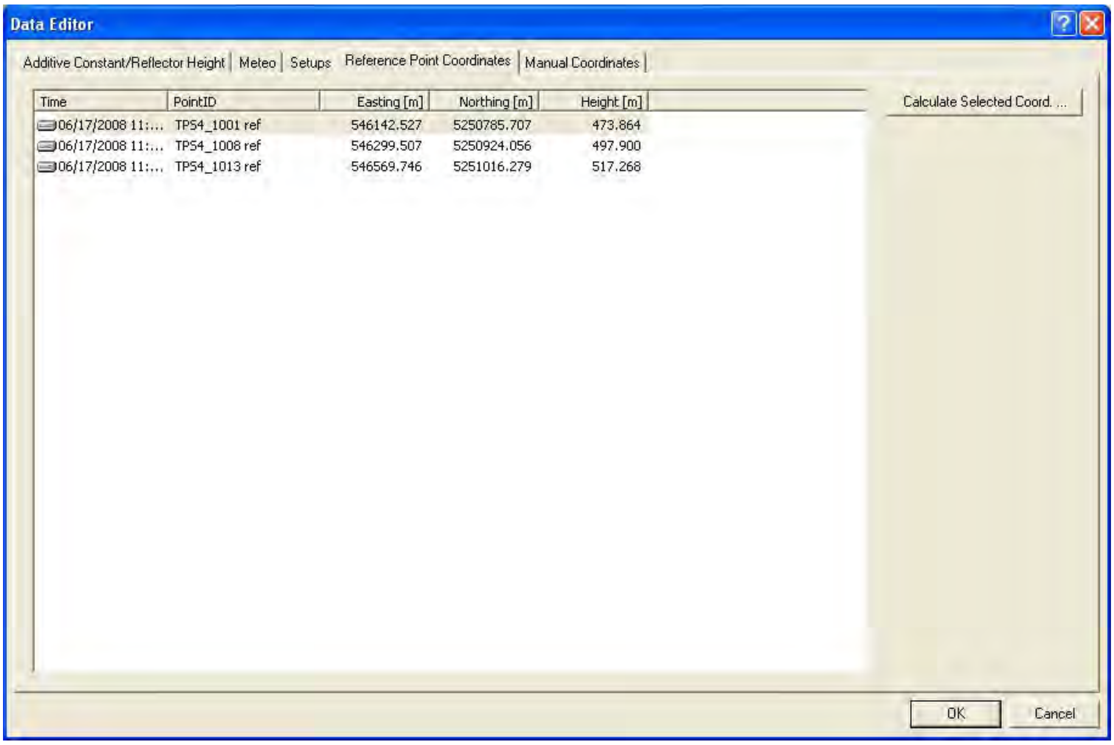
The reference point coordinates can be updated by directly editing the coordinates in the **Data Editor** or by approximating the displacement from the graph and using the displacement value to calculate the updated coordinates in a separate dialog, **Calculate Selected Coordinate**. The old reference coordinates are not saved. The new reference coordinates are valid from the time defined in the time column. Reference PPM calculations will not be processed for measurements occurring before the defined time of the reference coordinates.

The table shows all reference point coordinates of the defined time period. The reference points can be edited with the **Calculate Selected Coord. ...** button.

A point that belongs to a point group of the type Free Station, Distance Intersection, Orientation, PPM correction and Vz-correction, is automatically defined as a reference point. Only points defined as reference points are displayed in the Data Editor dialog. The reference point coordinates are measured in the automatic measurement cycle.

The **Point ID** column cannot be edited. Only the columns for **Time**, **Easting**, **Northing** and **Height** can be edited. It is not possible to add reference points directly in the table.

Reference Point Coordinates Properties



The table below describes the fields and buttons in the Reference Point Coordinates tab.

Field/Button	Description
Type	This column displays a icon symbol for the type of edited point and the unique point ID.  Original point value  Edited point value
Time	The date and time the reference point was measured.
Point ID	The reference point name.
Easting	The used easting value.
Northing	The used northing value.
Height	The used height value.

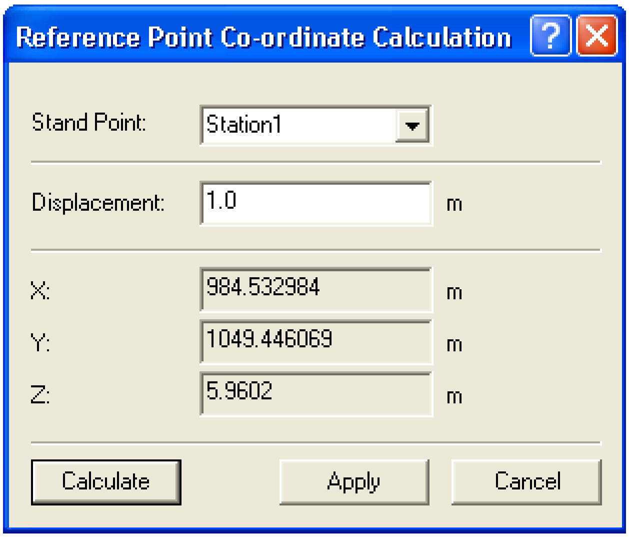
<table>
<tr>
<td>
</td>
<td>To calculate the selected coordinate following these steps.
<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>Select the menu Configuration, Post Processing.</td></tr>
<tr><td>2</td><td>The Post processing dialog appears.</td></tr>
<tr><td>3</td><td>Press the Data Editor button.</td></tr>
<tr><td>4</td><td>The Data Editor dialog appears.</td></tr>
<tr><td>5</td><td>Activate the Reference Point Coordinates tab.</td></tr>
<tr><td>6</td><td>Select a reference point.</td></tr>
<tr><td>7</td><td>Type in the updated coordinates for the reference point and enter the time. The time defines the period from when the coordinate is valid. Any measurements before this time will not be affected in relation to the reference point calculations.

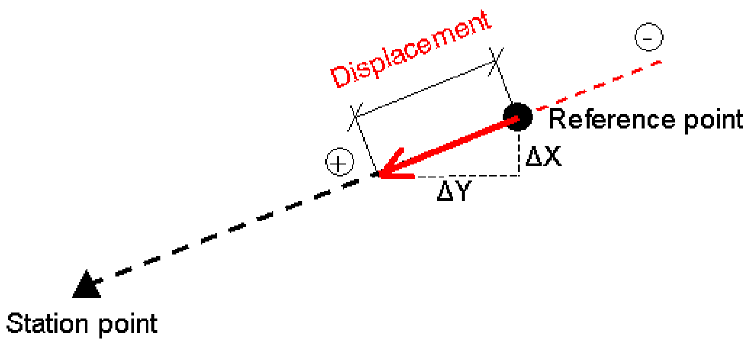
or press the Calculate Selected Coord. ... button.</td></tr>
<tr><td>8</td><td>The Calculate Selected Coordinate Calculation dialog is displayed.</td></tr>
<tr><td>9</td><td>Select the Stand point.</td></tr>
<tr><td>10</td><td>Enter the Displacement of the point previously</td></tr>
</table>
</td>
</tr>
</table>

	selected reference point relative to the current coordinate value.
11	Press the **Calculate** button to compute the displacement. The displacement is calculated in the direction from the reference target point to the standpoint and the reference coordinates are corrected respectively for the displacement in Easting and Northing.
12	Press **Apply** to confirm the displacement computation and the new reference point coordinates will be displayed in the Data Editor or **Cancel** to abort the displacement computation. When the coordinates are changed the time is automatically set to the current time.

Note:

The time should be edited after the coordinates have been changed. The reference coordinates are valid from the time defined in the time column. Reference point group calculations will not be post processed for measurements occurring before the defined time of the reference coordinates. Changing the time for the reference coordinates should be done with extreme care because it influences the time period of the post-processing calculations. Erroneous input can cause drastic effects in the calculations and post processing functionality.

<table>
<tr>
<td></td>
<td>




</td>
</tr>
</table>

OK	The Data Editor dialog will be closed and the data changes will be stored in the database.
Cancel	The Data Editor dialog will be closed and the data changes will not be stored in the database.

Further information

[Data Editor Overview]

[Data Editor: Additive Constant/Reflector Height]

[Data Editor: Meteo]

[Data Editor: Setups]

[Data Editor: Manual Coordinates]

Data Editor: Manual Coordinates

Background information

Type the coordinates of the manually measured points in the respective coordinate columns. Select the Point ID from the list in the Point ID column. The point must already exist in the system in order to enter manual coordinates. New points can be created in the Point Editor in the Monitor application. The time of the measurement can also be entered in the Date/Time column. The time is important for the correct chronological visualization in the graph and the computation analysis. Coordinates can be entered in the Easting, Northing and Height columns. Coordinates must be entered in the same coordinate system as defined for the system. The source of the coordinates can be from various measurements (e.g. GNSS, reduced Total Station, network adjustment). Upon entering a coordinate a displacement vector will be computed from the coordinate position and a result will be saved in the database. The results from the manual coordinate calculation can be viewed in the graph in the same manner as normal measurement results.

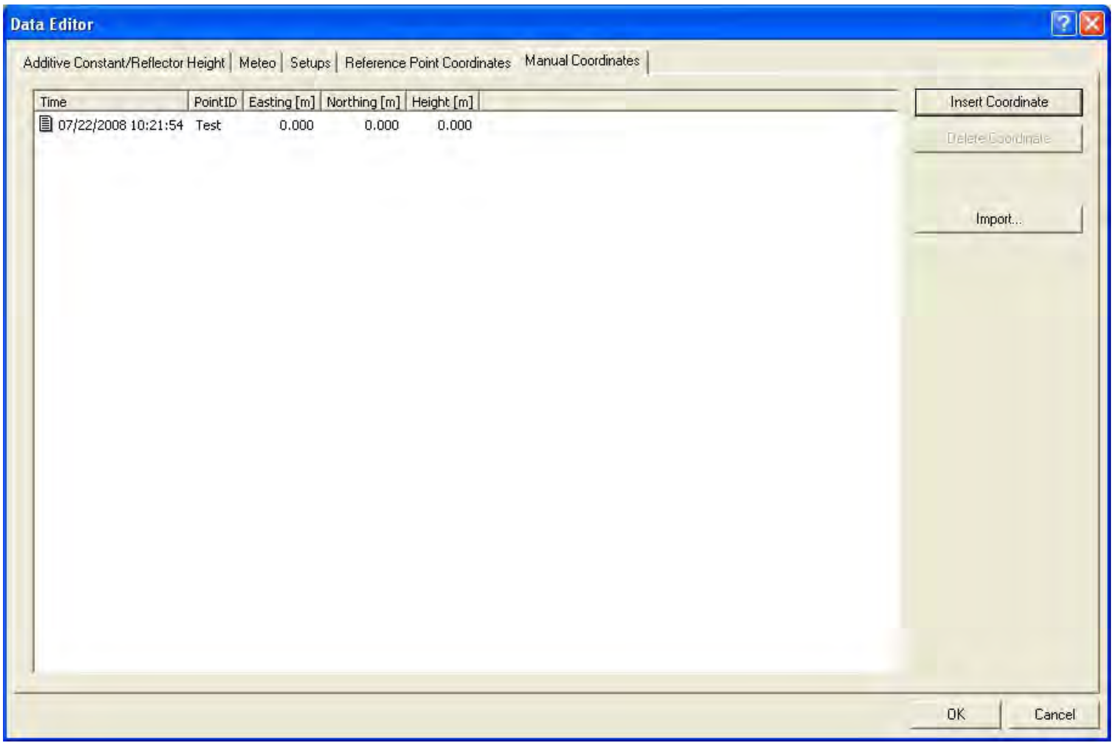
Process for manual entering coordinates

Follow these steps to manually enter coordinates.

Step	Action
1	Select the Point ID from the list.
2	Enter the time and coordinates of the manually observed points in the appropriate columns.
3	Press the **Calculate** button to calculate the results of the coordinates.
4	A result will be calculated based on the entered time and coordinate of the point. The calculation uses the current profile information assigned to the point. Every entry creates a separate result which can be viewed in the graph.

Manual Coordinates Properties

All data in the manual coordinates table can be modified. Right click on a field and select Modify.



The table below describes the fields and buttons in the Manual Coordinates tab.

Field/Button	Description
Time	The date and time the reference point was measured.
Point ID	The reference point name.
Easting	The used easting value.
Northing	The used northing value.
Height	The used height value.

Insert Coordinate	Press this button to insert a coordinate.
Delete Coordinate	Press this button to delete a coordinate. A coordinate must be selected before this button is activated.
Import...	Press this button to import a coordinate.

OK	The Data Editor dialog will be closed and the data changes will be stored in the database.
Cancel	The Data Editor dialog will be closed and the data changes will not be stored in the database.

Further information

Data Editor Overview

Data Editor: Additive Constant/Reflector Height

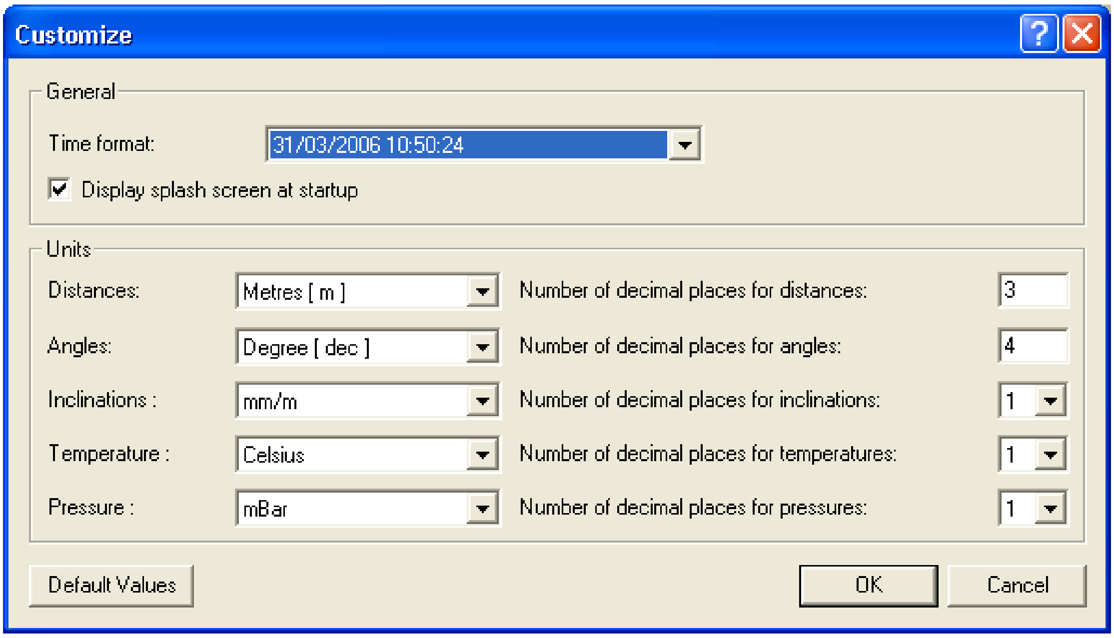
Data Editor: Meteo

Data Editor: Setups

Data Editor: Reference Point Coordinates

Customize

Follow this procedure to customize settings.

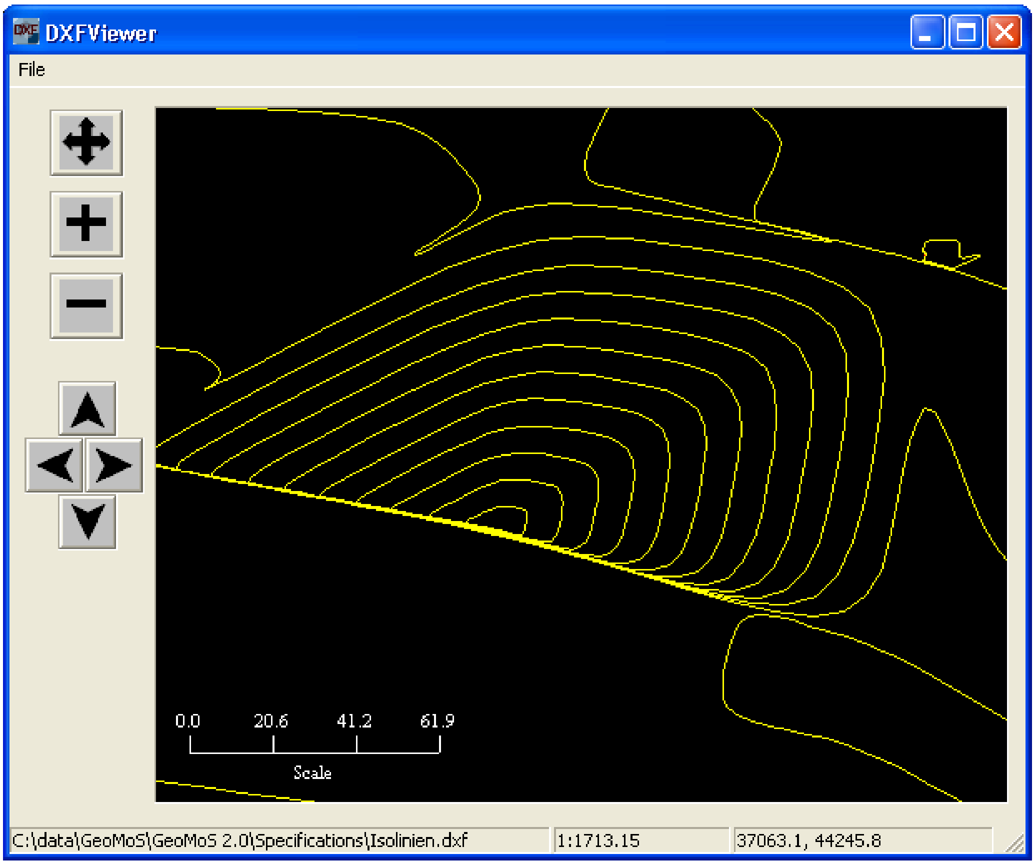
Step	Action
1	Select menu **Configuration**, **Customize...**.
2	The **Customize** dialog appears. 
3	Select a **time format** from the list. It is also possible to turn the **Splash window** during the start of the application on and off.
4	Select the **units** for distances, angles, inclinations, temperature and pressure.
5	Press the **OK** button. The selected options will then be active.

Tools

DXF Viewer

- Select from the menu **Tools**, **DXF Viewer...**.

Shows the DXF Viewer.



The following buttons are available: **Reset**, **Zoom in**, **Zoom out** and **Move** (the current graphic will be moved up or down, to the right or left)

Help

Help Topics

The help topics of the **GeoMoS Analyzer** application will be shown:

Step	Action
1	Select the **Menu ?**, **Help Topics**.
2	The **Help** dialog appears.
3	Search for the topic you are interested in and close the **help** dialog.
4	The dialog **Help** will be closed.

The **help** dialog can be used to read through the topics listed in the content window, to quickly go through the index or to search the help using key words.

About GeoMoS Analyzer

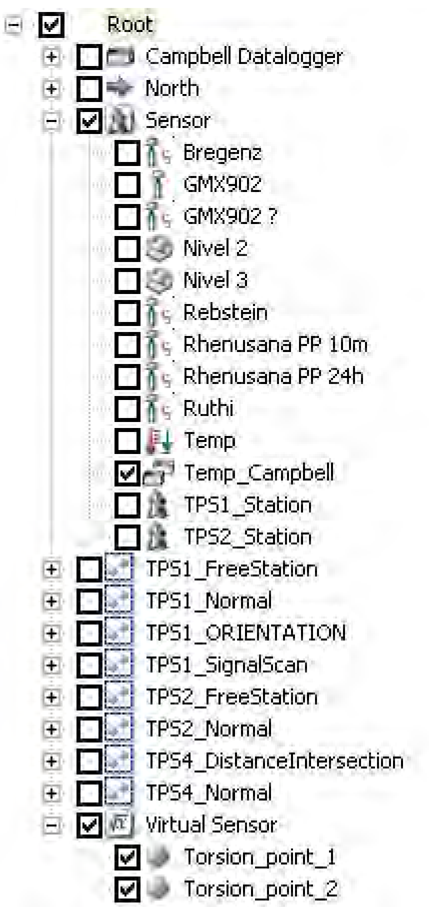
Information of the GeoMoS Analyzer will be displayed. The button "System Info" shows all relevant information about the current system.

Tree

Point Tree View

Background information

The tree view lists all points, profiles, point groups you created and the sensors stored in the database. The points, profiles, point groups and sensors can be selected for display in the graphics and reports. Set the check mark in front of the point, profile, point group or sensor in the tree to select it for display.



Note:

The specific sensor values, e.g. Total Station Compensator Longitudinal tilt, can only be displayed on the **Multiple Graphs** tab.

Change Selection

The point can be selected or de-selected by clicking the check box front of the point name. Selecting a point group, profile or sensor group automatically selects or de-selects all points

in the point groups or profile. Clicking the root node of the tree, selects or de-selects all points, point groups, profiles and sensors for display in the graphic.

Refresh of the Selection

Select a time period for the display of the desired points and press the refresh button  to refresh the graphic and reports.

Hint: Database changes e.g. new points and profiles are loaded to the Analyzer with the combination Shift + .

Step Mode

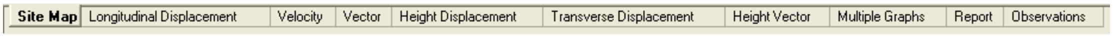
The Step Mode automatically selects a single point or profile one at a time. The current selected point or profile will be shown in the graphic.

Tabs

Tabs

Upon opening GeoMoS Monitor, tabs at the bottom of the view allow you to quickly switch from one view to another.

Tabs



Select from the menu **Configuration, Customize** to change the settings.

Site Map

Background information

The Site Map gives you a graphical overview of the status of the monitoring project. A background map can also be uploaded to enable thematic information to be seen.

Note:

- The site map is able to have one image stored as background map. The image must be geo-referenced one time before it can be shown as background map.
- Please read the topic geo-referencing for more information on this process.

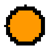
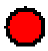
The Site Map shows as default the position of the Null Coordinates.

Topic contents

- Icons
- Move Points
- Show / Hide points
- Zoom
- Graphical Settings
- Site Map Context Menu
- Point Context Menu

Icons

The Site Map view shows the current status of the points using different colors (see table below). When the mouse is placed over a point, a context sensitive information box appears which gives more detailed information about that point.

Symbol	Description
	Limit ok
	Limit level 1
	Limit level 2
	Limit level 3

- The Site Map displays only limit levels that are not acknowledge.
- The Site Map displays only the highest priority of a limit level per point that occurred in the set limit level time range. The limit level time range can be customized and is not identical with the time period for the graphs and report.
- Select the menu **View**, **Refresh**, or press the toolbar **button Refresh**  or press **F5** to update the current status of the points.

Move points

The position of the points can be customized. Follow these steps to move points.

Step	Action
1	Right click on a point and select from the context menu the option Move.
2	The Analyzer shows the mouse cursor now as a **cross**.
3	Select with a single mouse click a new position in the Site Map.
4	The Analyzer places the point to the selected new position and deactivates the **Move** mode automatically. The cursor appears again as **arrow**.
5	The displayed position of each point is saved to the database. **Note:** To abort the Move mode select ESC or make a right-mouse click.

Show / Hide points

Points can be hidden in the Site Map. Follow these steps to hide and show points.

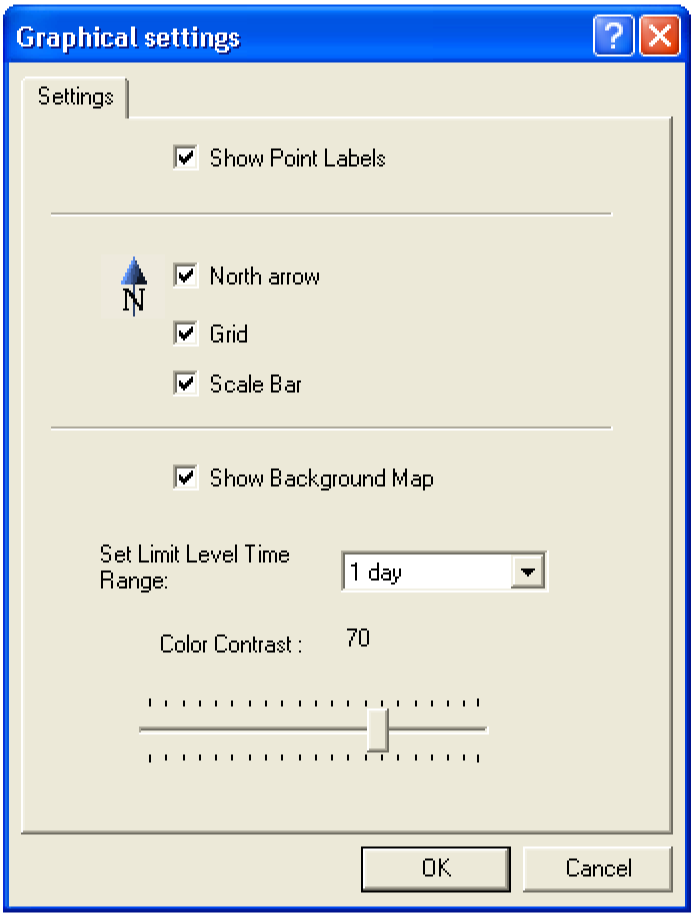
Step	Action
1	Right click on a point in the Site Map and select from the context menu the option **Hide**.
2	The Analyzer hides the point in the Site Map.
3	Points can be displayed again in the Site Map. Right click on a point in the Tree View and select from the context menu the option **Show**.
4	The point is displayed again in the Site Map.

Zoom

The Site Map menu allows you also to access the **Zoom In**, **Zoom Out** and **Zoom 100%** functions.

Graphical Settings

The layout of the graphic can be customized.



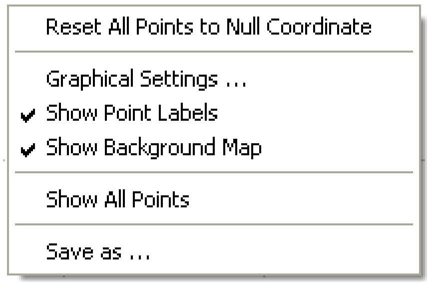
The table below describes the settings Graphical settings dialog box.

Setting	Description
Show Point Labels	When checked the point name is displayed.
North arrow	When checked the north arrow is displayed.
Grid	When checked a grid is shown.
Scale Bar	When checked a scale bar is shown.
Show Background Map	Activates and deactivates showing the background map in the **Site Map** tab. A background image has to be loaded and geo-referenced before it can be shown in the map view.
Set Limit Level Time Range	Allows you to restricts the number of displayed limits according to the selected time range.

Color contrast	Controls the intensity of color for the background map. A higher value gives stronger colors. This adjustment is directly connected to the same adjustment in the context menu of the Geo Referencing dialog.

Site Map Context Menu

A right mouse click in the Site Map will display the following menu on the screen.

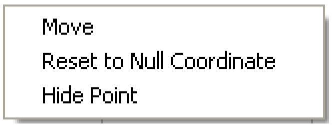


The table below describes each menu option.

Menu option	Description
Reset All Points to Null Coordinate	The positions of all points will be reset to the current Null Coordinate.
Graphical Settings...	Displays the Graphical Setting dialog.
Show Point Labels	Shows the point labels.
Show Background Map	Activates and deactivates showing the background map in the Site Map tab. This check is linked automatically to the Graphical Setting dialog. A background map image has to be loaded and geo-referenced before it can be shown in the map view.
Show All Points	To display all points in the Site Map tab. All hidden points will be shown again.
Save as	To save the site map in .jpg or .bmp format.

Point Context Menu

A right mouse click on a Point will display the following menu on the screen.



The table below describes each menu option.

Menu option	Description
Move	The position of the selected point can be customized with the Move option.
Reset to Null Coordinate	The position of the selected point will be reset to the current Null Coordinate.
Hide Point	To hide the selected point in the Site Map tab.

Displacement - Longitudinal, Transverse and Height

The displacement of the point movements of the selected points will be shown based on the time period settings. The time will be displayed on the horizontal axis and the displacement is displayed on the vertical axis.

The **point legend** contains the relationship to the different colored curves in the graph. It is also possible to show Comments in the graphic. The **comment legend** is indexed for each comment which is shown in the graphic.

The layout of the graphic can be customized. With a **double click** on the graphic the display properties of the selected object can be changed. The same is possible by pressing the **right mouse button and selecting the properties menu**. The **properties** dialog appears. There are various options available to change the display properties of the graphics.

By default the connecting line of a graphic is interrupted between two measurements if the time difference is bigger than 1 day. This setting is stored as MaxDiffDays = 1 in the "GeoMoS Graphics.ini" file and may be modified if required.

The contents of the graphic can be defined with the graphic options menu:

Options Longitudinal Displacement

Options Transverse Displacement

Options Height Displacement

Velocity

The **velocity** of the point movements of the selected points will be shown based on the time period settings. The time will be displayed on the horizontal axis and the velocity is displayed on the vertical axis.

The **point legend** contains the relationship to the different colored curves in the graph. It is also possible to show Comments in the graphic. The **comment legend** is indexed for each comment which is shown in the graphic.

The layout of the graphic can be customized. With a **double click** on the graphic the display properties of the selected object can be changed. The same is possible by pressing the **right mouse button and selecting the properties menu**. The **properties** dialog appears. There are various options available to change the display properties of the graphics.

The contents of the graphic can be defined with the graphic options menu: Options Velocity

Vector

The **point displacement** of the selected points will be shown as a **displacement vector length**. The displacement vector of the selected points will be shown as a plan view (i.e. coordinate position), the direction of the movement and the length of the vector shows the magnitude of the displacement. The displacement vector is based on the defined profile for the point. The axis shows the plane coordinates for the selected coordinate system. The Easting is displayed on the horizontal axis and the Northing is displayed on the vertical axis.

The layout of the graphic can be customized. With a **double click** on the graphic the display properties of the selected object can be changed. The same is possible by pressing the **right mouse button and selecting the properties menu**. The **properties** dialog appears. There are various options available to change the display properties of the graphics.

The contents of the graphic can be defined with the graphic options menu: Options Vector

Height Vector

The **point displacement in the height only** of the selected points will be shown as a **displacement vector length**. The displacement vector of the selected points will be shown as a plan view (i.e. coordinate position), the direction of the movement (up or down) and the length of the vector shows the magnitude of the displacement. The displacement vector is based on the defined profile for the point. The axis shows the plane coordinates for the selected coordinate system. The Easting is displayed on the horizontal axis and the Northing is displayed on the vertical axis.

The layout of the graphic can be customized. With a **double click** on the graphic the display properties of the selected object can be changed. The same is possible by pressing the **right mouse button and selecting the properties menu**. The **properties** dialog appears. There are various options available to change the display properties of the graphics.

The contents of the graphic can be defined with the graphic options menu: Options Vector

Report

Background information

The **report** is one of the main tab pages of the Analyzer main windows. The report shows the most important measurements and results of the selected points. It is possible to sort the columns ascending or descending. It is also possible to hide and show the different columns, by pressing the right mouse button on the column header to select a option.

Topic contents

Click the following links for further information contained in this topic.

Report Tab Properties

The columns of the report can be displayed or hidden as desired. The contents of the columns can be sorted ascending or descending.

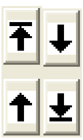
The table below describes the fields in the Report tab.

Field/Button	Description
State	The state is set to valid or invalid. Only valid results are displayed in the Displacement graphs.
Point ID	The name of this individual point.
Profile Name	The used profile for the particular measurement. The profile direction

	defines the direction (i.e. azimuth) in which the displacement is determined.
Time	The time of the particular measurement.
Hz	The measured Hz angle for the particular measurement. **Note**: The displayed Hz angle depends on the measured telescope positions. In case of: ▪ face **I** measurements, the Hz angle (face **I**) is displayed ▪ face **II** measurements, the Hz angle (face **II**) is displayed ▪ face **I** + face **II**, measurements the combined Hz angle (face **I** + face **II**) is displayed
V	The measured V angle for the particular measurement. **Note**: The displayed V angle depends on the measured telescope positions. See the above description for **Hz** for more information.
D	The measured slope distance for the particular measurement. **Note**: The displayed slope distance depends on the measured telescope positions. See the above description for **Hz** for more information.
PPM Type	The used ppm type (Temperature / Pressure = AtmosPPM or Reference Distance correction = RefPPM) for the particular measurement.
PPM	The used ppm value for the particular measurement.
Pressure	The used pressure for the particular measurement.
Av Temp	The used temperature for the particular measurement.
Add Const	The used additive constant for the particular measurement.
Target Easting	The computed easting coordinate of the target.
Target Northing	The computed northing coordinate of the target.
Target Elevation	The computed height coordinate of the target.
Reflector Height	The used reflector height for the particular measurement.
Instrument Height	The used instrument height for the particular measurement.

Station Easting	The used station coordinate for the particular measurement.
Station Northing	The used station coordinate for the particular measurement.
Station Height	The used station coordinate for the particular measurement.

Null Measurement	
Diff Null Measurement	The computed **longitudinal displacement** of the particular measurement. The profile direction defines the direction (i.e. azimuth) in which the displacement is determined.
Horz Distance	The corrected and reduced horizontal distance.
Difference Outlier	The value may computed with the **Calculate Outlier** button.
Transverse Displacement	The computed transverse displacement of the particular measurement. The profile direction defines the direction (i.e. azimuth) in which the displacement is determined.
Height Displacement	The computed transverse displacement of the particular measurement.
Point Group	The point group in which the particular measurement was done.

Calculate Outliers	Calculates the outliers (results are outside the standard deviation) according to the value selected in the Confidence Interval list box.
Confidence Interval	Used confidence interval for outlier calculation.
Save All	All numerical values are saved within the time range to a .CSV file.
	Allow you to scroll through the listed data.

Outlier Tests

The calculated data can be tested for outliers. The outlier test is integrated in the **Report** tab. The outlier test calculation uses the displacement vector in the profile direction. A linear regression solution is fitted through the measurements. The individual measurements are tested for the probability that the measurement lies statistically on the line for the defined confidence interval +/- 95.0 %, 97.5 % or 99.0 %. All measurements that are outside the defined standard deviation will be marked as outliers.

Follow these steps to perform an outlier test.

Step	Action
1	Select the **Report** tab and choose the desired **Confidence Interval** from the list.
2	Click the **Calculate Outlier** button.
3	The outliers will be determined based on the selected confidence interval and will be marked with an exclamation icon,  , in the Report.

The outliers are only determined from the measurements that are listed in the Report. The overall result of the outlier test will be displayed in a message box. The residual of the measurements calculated from the linear regression will be displayed in a separate column for each measurement in the Report. The residual and the exclamation icon are only temporarily displayed in the Report tab and are not saved in the database. The calculated outlier values and icon symbol will be re-initialized when the selected points are refreshed.

Remark:

When the selected points are changed, the **Refresh**  button must first be pressed to display the measurements that are used for the outlier tests.

Setting Results to Valid/Invalid

The results in the Report can be set to invalid or valid. When a result is set to invalid it will not be shown in the graph. The outlier test is a helpful tool to indicate which results are outside the standard deviation and assist in the decision to mark a result as invalid.

Follow these steps to set Results to Valid or Invalid.

Step	Action
1	Select the **Report** tab. The valid results have a check mark in the Point ID column. For an invalid result the check mark is not displayed.
2	Set the result to invalid if the result should not be displayed in the graph. The result can be reset to valid at any time by setting the check mark again.

The valid or invalid status is saved for each result in the database. Invalid results are not deleted from the database. Invalid results can always be reset to valid. When the data is edited or post processed the status remains unchanged even if the result has changed.

The results set as invalid are not displayed in the graphic. The graph curve connects the last valid result to the next valid result as a continuous line. The effect on the graphic can be seen by setting results valid or invalid and pressing the refresh button in the **Displacement** graphic. Invalid results will not be shown in the graphic.

Important: The valid or invalid status has no effect on the Multiple Graphs tab.

Export the report

The contents of the active report (report pane, data editor, comment editor) will be export in an ASCII file format.

Follow these steps to export a report.

Step	Action
1	Press the right mouse button in the report view and select **Save As...** from right mouse menu.
2	The **Save** dialog appears.
3	Select a **folder** where you want to store the file and type in a **file name**. Select one of the available formats ***.txt**, ***.csv** or ***.prn**.
4	Press **Save** to create an ASCII file.

The system closes the dialog and creates a export file of the current active report in the selected folder with the selected filename.

Notice: Only the visible columns will be exported. If there is no selected lines in the table, the whole table will be exported. If lines have been selected only the selected lines will be exported.

Format	Description
TXT	The columns will be separated by a tabulator.
CSV	The columns will be separated by a comma. This format can be directly imported to EXCEL.
PRN	This file format can be used for printing.

Printing the Report

Follow these steps to print the report.

Step	Action
1	Select with the right mouse menu **Print...** or select the menu **File, Print...** or click the toolbar Print button or press **Ctrl+P**.
2	The **Print** dialog is displayed.
3	Change the print settings as required.
4	Click the **OK** button. The **Print** dialog will be closed and the report will be printed with the selected settings.

Observations

The table displays the individual measurements from the **Geotechnical Sensors** connected to the Monitoring System. Every Sensor can be assigned to a point in the **Sensor Location** dialog.

The Monitor and Analyzer Observations tab is identical.

Field	Description
Sensor	The name of the connected Sensor will be displayed.
Point ID	The Sensor is assigned to a point in the **Sensor Location** dialog. This Point ID will be displayed.
Time	The measurement time is displayed.
Values	Dependant on the connected Sensor the measured values are displayed. For a temperature-pressure Sensor, the measured temperature and pressure values are displayed.

Multiple Graphs

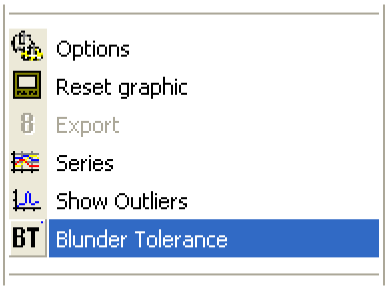
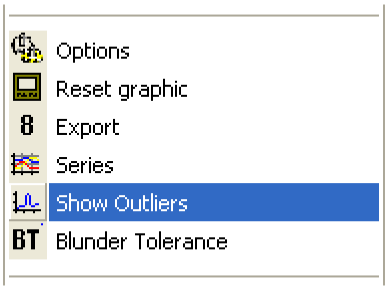
Multiple Graphs

Background information

The movements and measurements of the selected points, profiles or sensors will be shown based on the time period settings. The time will be displayed on the horizontal axis and the series are displayed on the vertical axis.

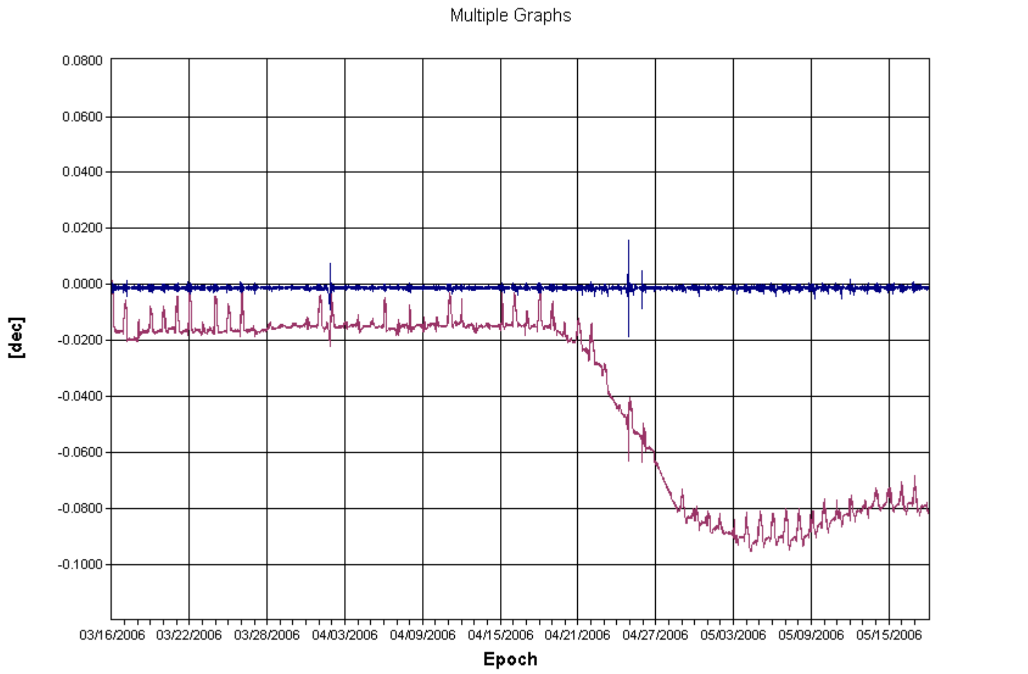
The table below describes the functionality in the Multiple Graphs tab.

General	Description
Graph	The displayed graphs can be selected with the Series dialog. Select the **right mouse menu** and select the **Series** entry.
Legend	The point legend contains the relationship to the different colored curves in the graph. It is also possible to show Comments in the graphic. The **comment legend** is indexed for each comment which is shown in the graphic.
Layout	The layout of the graphic can be customized. With a **double click** on the graphic, the display properties of the selected object can be changed. The same is possible by pressing the **right mouse button and selecting the properties menu**. The **properties** dialog appears. There are various options available to change the display properties of the graphics.
Content	The contents of the graphic can be defined with the graphic options menu: Options Multiple Series. Select the **right mouse menu** and select the **Options** entry.

Specific content	
Data that exceeded the blunder tolerance  	Total Station raw measurements that **exceeded the blunder tolerance** can be hidden. Select the **right mouse menu** and set the **Blunder Tolerance** entry to active or not active.
Data that is set to valid or invalid  	Each measurement has a state, which can be set to valid or invalid. An invalid measurement state, is a so-called outlier. Select the **right mouse menu** and set the Show Outliers entry to active or not active in order to show or hide outliers.

Examples

The graphic displays the raw Hz angle and the orientation corrected Hz angle to a monitoring point.


Multiple Graphs
0.0800
0.0600
0.0400
0.0200
0.0000
-0.0200
-0.0400
-0.0600
-0.0800
-0.1000
[dec]
03/16/2006
03/22/2006
03/28/2006
04/03/2006
04/09/2006
04/15/2006
04/21/2006
04/27/2006
05/03/2006
05/09/2006
05/15/2006
Epoch

Series

Topic Contents:

Background Information

The **Series** dialog is part of a powerful graphing tool used to display

- stand   ard series and/or
- v   elocity series

in a single graphic.

The **graphics** of the selected points, profile, physical sensor or virtual sensor will be shown within the defined time period. The time is displayed on the horizontal axis and the selected series is displayed on the vertical axis.

- The series graphics are subdivided in two groups: Standard and Velocity series.
- The additional functions and display properties for the series graphics can be accessed as usual with the buttons on the Graphic toolbar.
- The contents of the series graphic can be defined with the graphic options menus: Multiple Series 1 and Multiple Series 2.

Note:

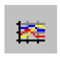
The **Series** dialog can only be accessed on the **Multiple Graphs** tab.

Velocity graph types

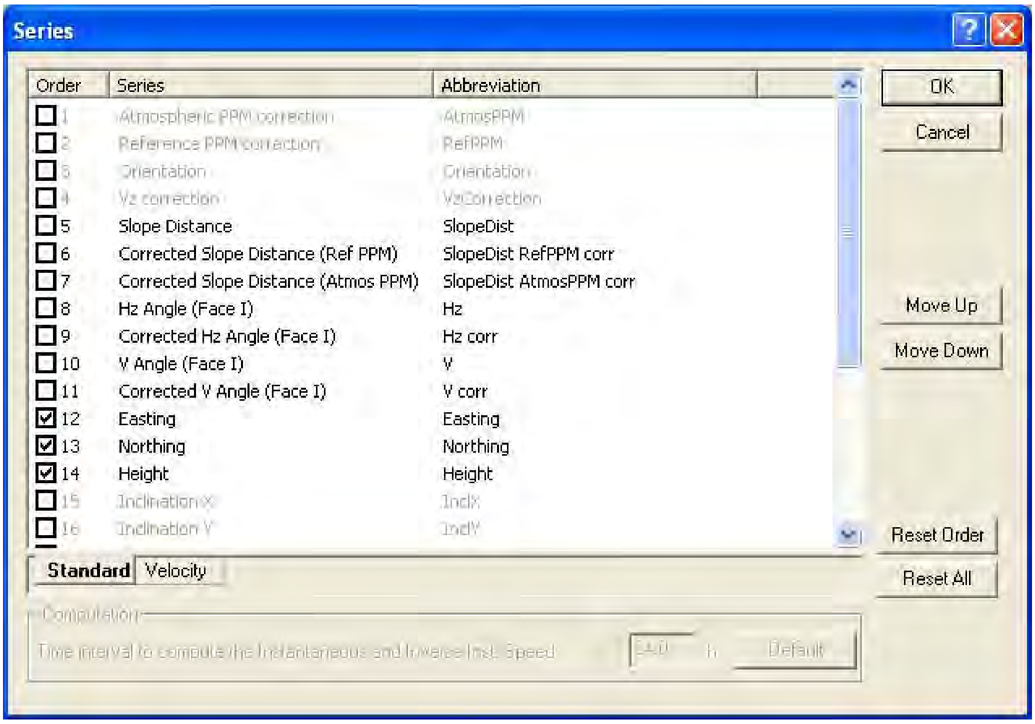
In GeoMoS Analyzer you can display four types of velocity graphs:

Instantaneous Velocity	The velocity is shown on an epoch by epoch basis. Each set of data (e.g. coordinates) is compared to the previous set of data. You can define the time interval in the computation field.
Accumulated Velocity	The velocity is shown by comparing each successive set of data (e.g. coordinates) with a value at a specified earlier time, which you define when you set the start time in the viewer.
Inverse Instantaneous Velocity	This allows you to look at the number of days it would take to displace a defined distance at the current velocity. It is the reciprocal value of the Instantaneous Velocity.
Inverse Accumulated Velocity	This allows you to look at the number of days it would take to displace a defined distance at the current velocity. It is the reciprocal value of the Accumulated Velocity.

Open the Series dialog

Step	Action
1	Select the **Multiple Graphs** tab.
2	Right-mouse click and select **Series** from the context menu or press the button  in the graphic toolbar.
3	The **Series** dialog will be displayed.
4	The Series dialog consists of two tabs: The **Standard series** tab and the **Velocity series** tab.

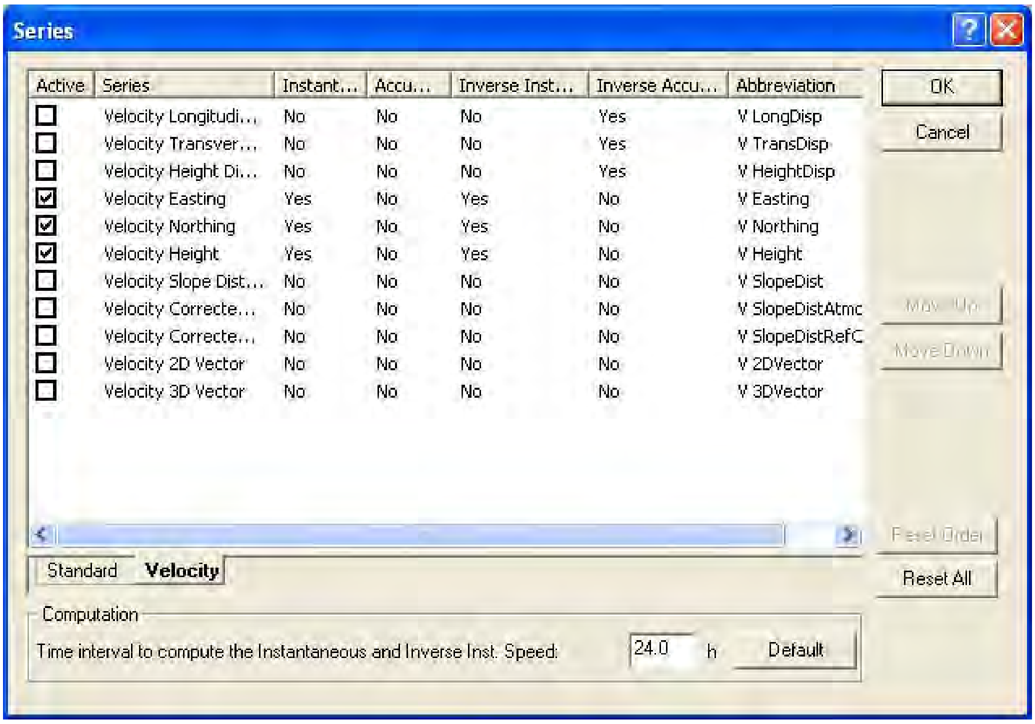
Standard series



Field	Description
Order	This check box is used to activate and deactivate series. Only active series will be displayed on the Multiple Graphs tab. The scale of the 1st series and associated unit is displayed on the left hand side. The scale of the 2nd series and associated unit is displayed on the right hand side. The order of the series can be changed with the Move Up and Move Down buttons. **Note:** Only two different units can be displayed at the same time on the **Multiple Graphs** tab.
Series	Displays the current available series on the Multiple Graphs tab.
Abbreviation	The point legend contains the relationship to the different colored curves in the graph. In addition to the point name the abbreviation of the series name is displayed.

Move Up	The current series will be moved in the order up.
Move Down	The current series will be moved in the order down.
Reset Order	The current series order will be reset to the default order.
Reset All	The complete series dialog will be reset to the default dialog.

Velocity series



Field	Description
Active	This check box is used to activate and deactivate series. Only active series will be displayed on the Multiple Graphs tab.
Series	Displays the current available series on the Multiple Graphs tab.
Instantaneous Velocity	Right mouse click to display the Instantaneous Velocity (Yes) or not (No) of the selected series.

Accumulated Velocity	Right mouse click to display the Accumulated Velocity (Yes) or not (No) of the selected series.
Inverse Instantaneous Velocity	Right mouse click to display the Inverse Instantaneous Velocity (Yes) or not (No) of the selected series.
Inverse Accumulated Velocity	Right mouse click to display the Inverse Accumulated Velocity (Yes) or not (No) of the selected series.
Abbreviation	The point legend contains the relationship to the different colored curves in the graph. In addition to the point name the abbreviation of the series name is displayed.
Computation	In this field you can modify the time interval to compute the Instantaneous and Inverse Instantaneous Velocity. The valid range is from 0.1 to 48.0 hours. Per default the value is 24 hours.

Move Up	Not available.
Move Down	Not available.
Reset Order	Not available.
Reset All	The complete series dialog will be reset to the default dialog.
Default	Press **Default** to reset the time interval to the default value (24 hours).

Available Series

Standard series:

Refer to Observation Types for more detailed information about the **standard series**.

Velocity series:

This table lists all pre-defined **velocity series** observation types in the GeoMoS software.

Velocity system observation types	Description	System Unit
Velocity Longitudinal Displacement	Calculated velocity from the computed coordinate component displacement (Longitudinal Displacement) related to the Null coordinate.	Distance per day
Velocity Transverse Displacement	Calculated velocity from the computed coordinate component displacement (Transverse Displacement) related to the Null coordinate.	Distance per day
Velocity Height Displacement	Calculated velocity from the computed coordinate component displacement (Height Displacement) related to the Null coordinate.	Distance per day
Velocity Easting	Calculated velocity from the computed coordinate component (Easting).	Distance per day
Velocity Northing	Calculated velocity from the computed coordinate component (Northing).	Distance per day
Velocity Height	Calculated velocity from the computed coordinate component (Height).	Distance per day
Velocity Slope Distance	Calculated velocity from the slope distance. Totals stations only.	Distance per day
Velocity Corrected Slope Distance (Atmos PPM)	Calculated velocity from the meteorological (temperature and pressure: Atmos PPM) corrected slope distance. Totals stations only.	Distance per day
Velocity Corrected Slope Distance (Ref	Calculated velocity from the geometrical (measurements to control points: Ref PPM) corrected slope distance. Totals	Distance per day

PPM)	stations only.	
Velocity 2D Vector	Calculated velocity from the computed 2D vector components (Easting and Northing)	Distance per day
Velocity 3D Vector	Calculated velocity form the computed 3D vector components (Easting, Northing and Height)	Distance per day

Outliers

Background information

In the tabbed view Multiple Graphs it is possible to set a state for each measurement. The state is set to valid or invalid. An invalid measurement state, is a so-called outlier and in the tabbed view Multiple Graphs it is possible to hide or show these outliers.

Notes:

- The outlier selection in the tabbed view Multiple graphs is only valid for the tabbed view Multiple graphs. In the tab Report it is also possible to set Outliers for coordinates and displacements, but this selection affects all tabs..
- This outlier selection is only possible for standard series. If you would like to select an outlier of a velocity series, then you have to select the outlier of the appropriate standard series because the velocity series are dependent on the standard series.

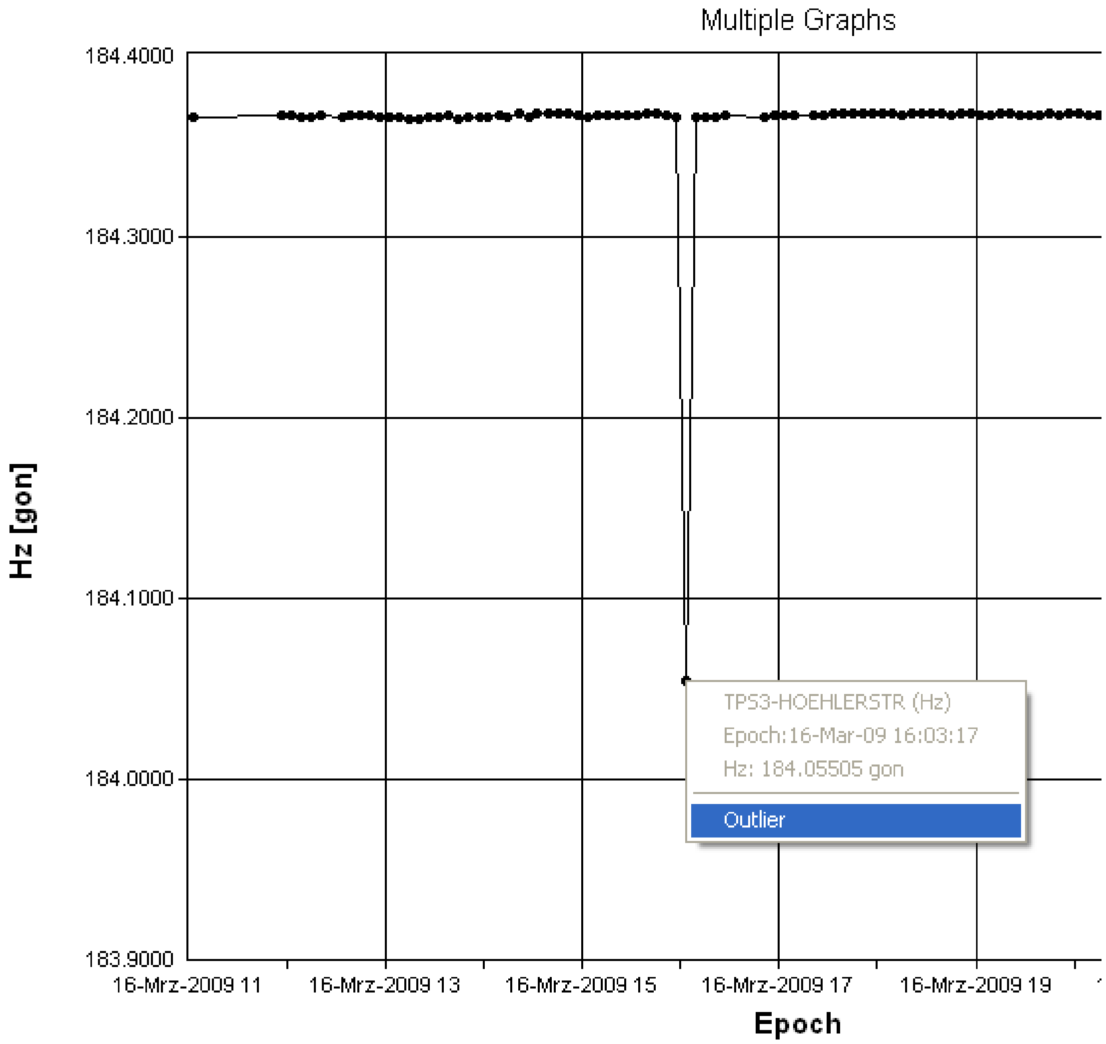
Topic contents

- Set outliers and display graphs without outliers
- Display graphs with or without outliers
- Reset outliers

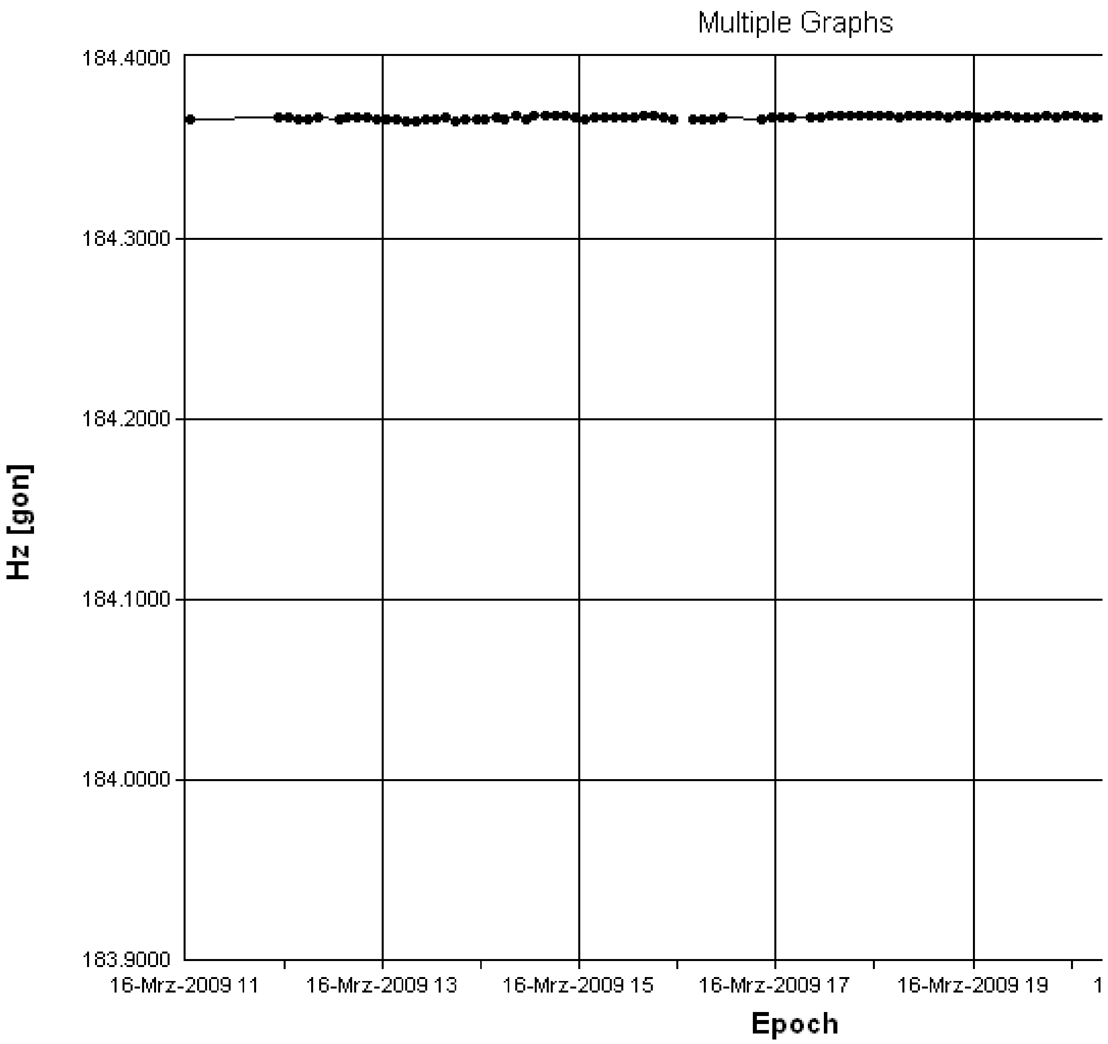
Set outliers and display graphs without outliers

Follow these steps to select measurements and set outliers.

Step	Action
1	Select in the **Multiple Graphs** tab.
2	To select an outlier, right-click on the appropriate data point (outlier) and select **Outlier**.



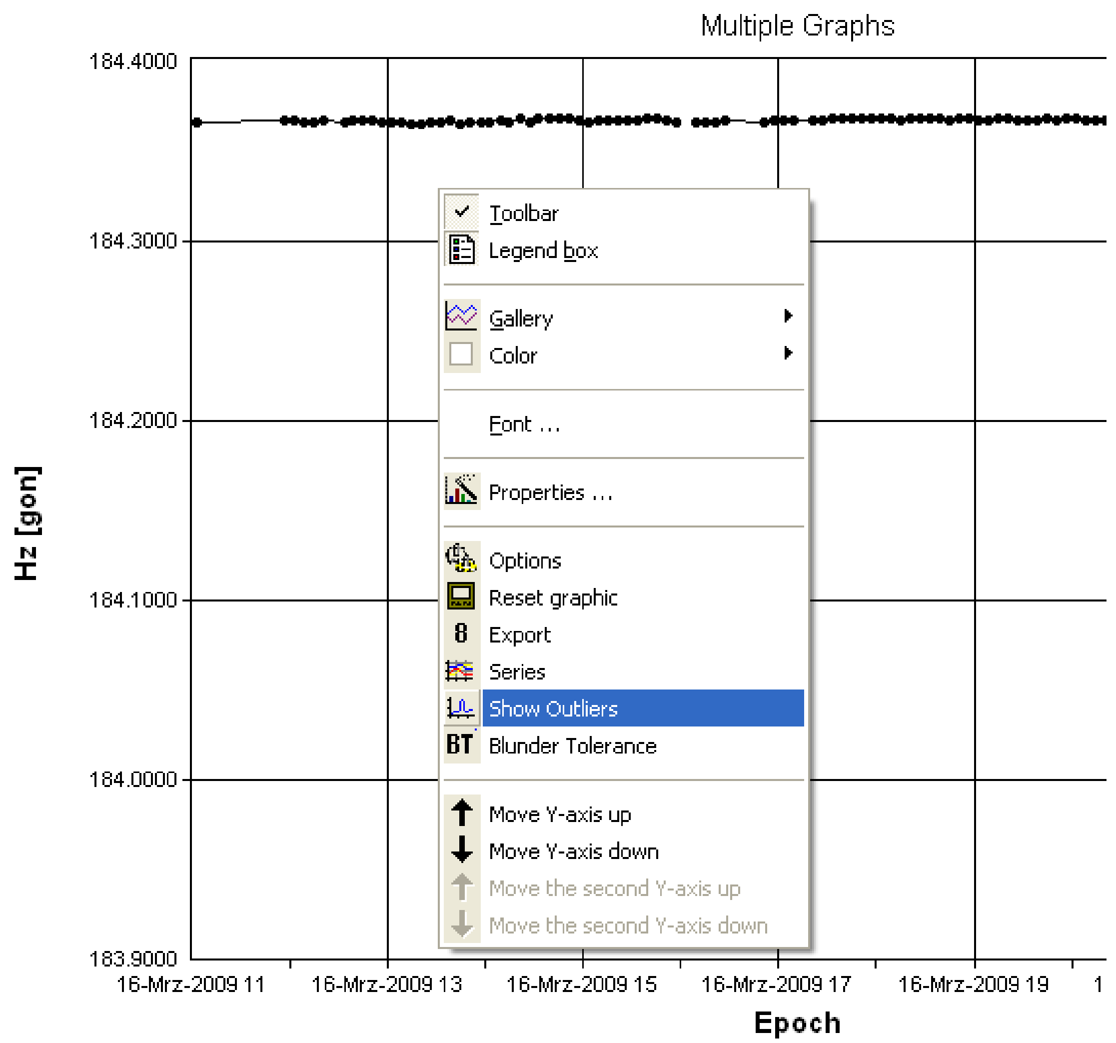
3	After selection, the outlier is hidden automatically by default.

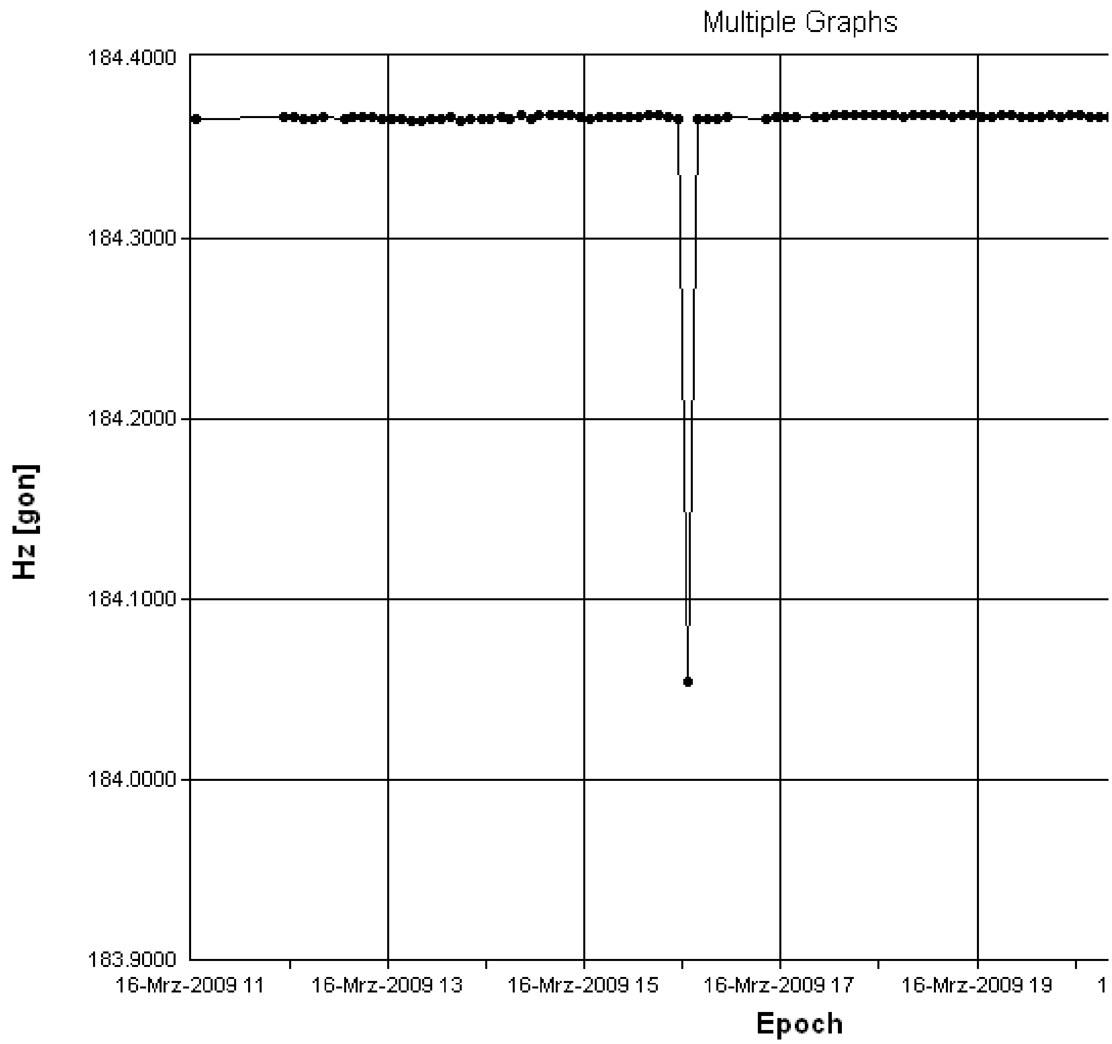
	
4	To display all outliers, right-click somewhere in the graphic (not on a point) and select **Show Outliers**.

Display graphs with or without outliers

Follow these steps to select measurements and set outliers.

Step	Action
1	Select the **Multiple Graphs** tab.
2	To display all outliers, right-click somewhere in the graphic (not on a point) and select **Show Outliers**.

	
3	Press the **Refresh** button  in the Configuration Toolbar to refresh the view. All data points are displayed again from the same series, with outliers now shown. You can check this with a right-click on an outlier.

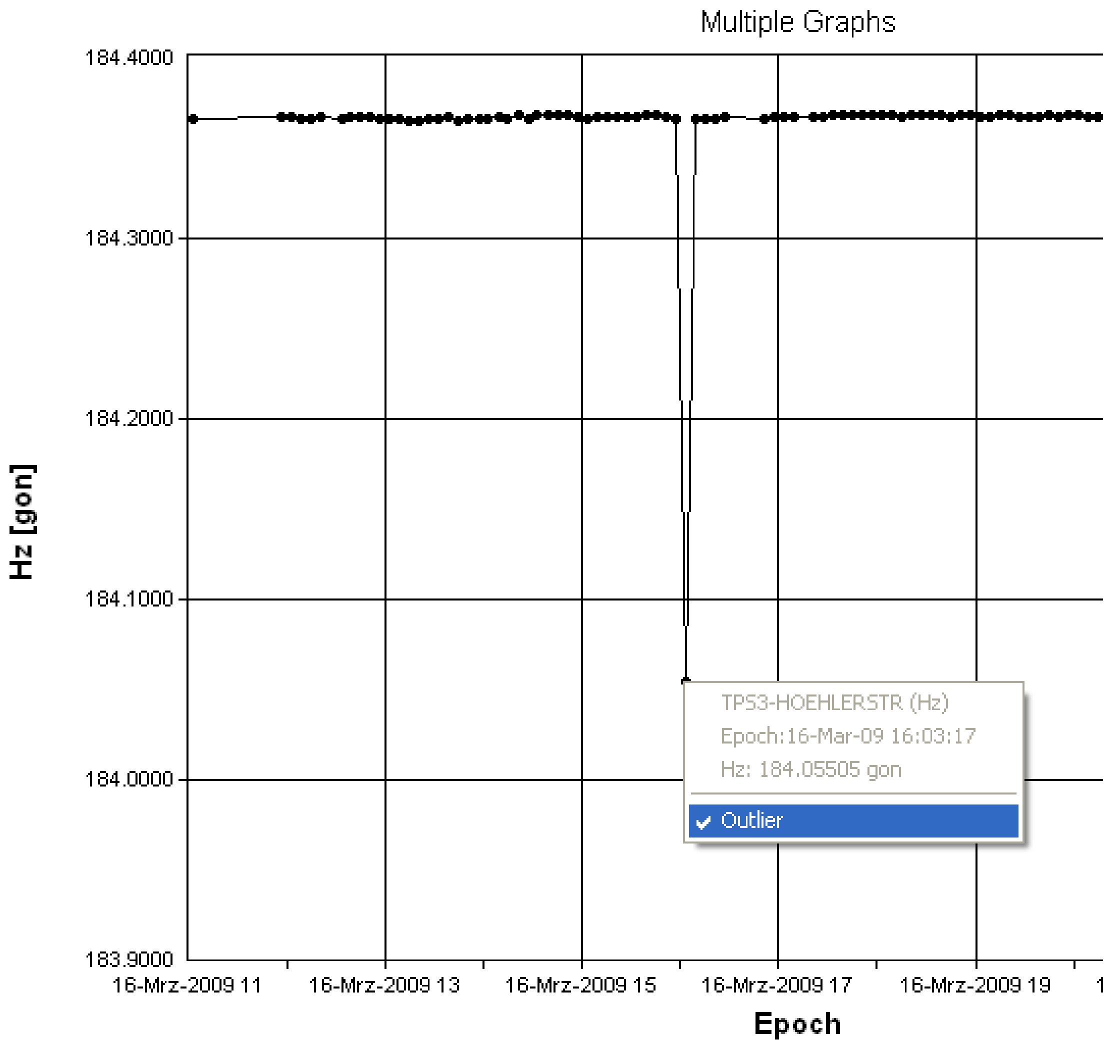
	
4	To hide the outliers again, right-click somewhere in the graphic and de-select **Show Outliers**. Press the Refresh button in the Configuration Toolbar to make a refresh of the view. From now on the outliers will be hidden.

Reset outliers

Follow these steps to select measurements and set outliers.

Step	Action
1	Select the **Multiple Graphs** tab.
2	To de-select an outlier, display all Outliers (see above), then right-click on the appropriate

outlier and select **Outlier**.



After the selection the outlier is deselected.

Graphics & Context Menu

Background information

The **graphics** of the selected points will be shown within the defined time period. The time is displayed on the horizontal axis and displacement or velocity is displayed on the vertical axis. The vectors of the selected points will be shown as a plan view.

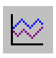
The **legend** contains the relationship to the different colored curves in the graph. It is also possible to show Comments in the graphic. The **comment legend** is indexed for each comment which is shown in the graphic.

The layout of the graphic can be customized. With a **double click** on the graph the display properties of the selected object can be changed. The same is possible by pressing the **right mouse button and selecting the properties menu**. The **properties** dialog appears. There are various options available to change the display properties of the graphics.

The contents of the graphic can be defined with the graphic options menus: Displacements, Velocity, Vector, Height.

Graphic Toolbar

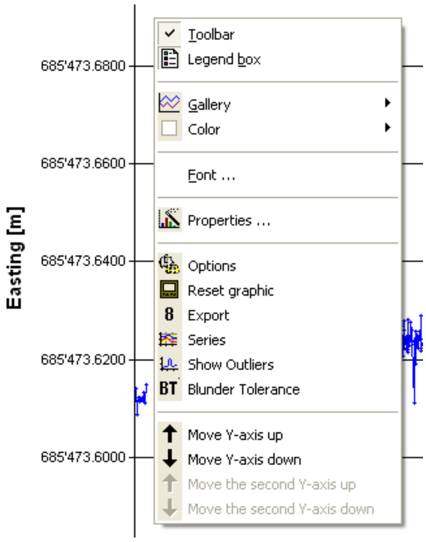
A special toolbar for the graphics can be shown. Additional functions and display properties for the graphics can be accessed with the buttons on the toolbar.

Icon	Function	Description
	**Save Chart**	The current graphic can be stored in different formats.
	**Gallery**	Different graphic types can be selected.
	**Color**	Different colors for different elements in the graphic can be selected.
	**Vertical**	The vertical grid can be selected.

	grid	
	Horizontal grid	The horizontal grid can be selected.
	Legend box	The legends can be turned on and off.
	Properties	Selecting Properties opens a separate dialog box. Each tab allows customizing of the graphics. Click on the screen shot for more information. 
	Zoom	It is possible to zoom in and out on a region of the graphic with the mouse. By pressing the left mouse button and dragging a rectangle in the graphic area, an area of the graph can be enlarged. To return to the original graphic (without zooming), press the zoom toolbar button again.
	Tools	Legend and toolbar buttons can be activated and deactivated.
	Options	The options of the selected graphic can be edited.
	Reset graphic	The current graphic will be shown centered.
8	**Export**	The current graphic will be exported in a comma separated csv file.
↑ ↓ → ←	**Move**	The current graphic will be moved the Y-axis up or down, to the right or left.

Context Menu

With a right-click on the Main Window, a Context-Menu is available. A Context-Menu lists all useful commands at a particular instant for a particular item on the screen.



Menu Item	Description
Toolbar	The toolbar can be turned on and off.
Legend	The legends can be turned on and off.
Gallery	Different graphic types can be selected.
Color	Different colors for different elements in the graphic can be selected.
Point labels	Lets you show/hide the point labels.
Font	The font, font style, size, effect, color and script can be selected.
Properties	Selecting Properties opens a separate dialog box. Each tab allows customizing of the graphics. Click on the screen shot for more information. 
Options	The options of the selected graphic can be edited.
Reset Graphic	The current graphic will be shown centered.
Export	The current graphic will be exported in a comma separated csv file.
Series	Opens the Series dialog. Available series can be selected.
Show Outliers	In the tabbed view Multiple Graphs it is possible to set a state for each measurement. The state is set to valid or invalid. An invalid measurement state, is a so-called outlier and in the tabbed view Multiple Graphs it is possible to hide or show these outliers.
Blunder Tolerance	If the resulting coordinate is further from the last position (3D) than the configured Blunder Tolerance, then it will be regarded as a blunder and only the raw measurements will be stored in this database. No result will be computed. In the Multiple Graphs tab raw measurements graphics can be displayed with

	or without these blunders.
Move	The current graphic will be moved the Y-axis up or down, to the right or left.

Menu Item	**Description**
Font	The font, font style, size, effect, color and script can be selected.
Color	Different colors for different elements in the graphic can be selected.

Properties: The Properties dialog shows all possibilities for customizing the graphics.

Properties

Each tab in the Chart FX Properties dialog allows customizing of the graphics. Click on the screen shot for more information on each tab.

General Tab

The table below describes the settings in the General Tab.

Setting	Description
Cluster	Lets you display series in different rows along the z-axis.
Stacked	Displays the chart in stacked, stacked 100% or normal mode.
Axis Style	Applies a specific painting style to the axis.
Grid lines	Displays horizontal or vertical gridlines at the major interval of the numerical (y) or categorical (x) axis, respectively.
Palette	Select a specific palette to change all elements in the chart area.
Scheme	Sets a specific scheme to elements in the chart area. Default is solid colors, you can also choose B&W or colored patterns.
Background	Click the color you want in the area surrounding the chart.
Chart Box	Click the color you want in the plot area.

Series Tab

The table below describes the settings in the Series Tab.

Setting	**Description**
Series Selector	Choose a particular series or <<All series>> to apply different formats an options.
Fill Color	Click the fill color you want for the selected series.

Lines	
Same as color markers	The line will be drawn using the fill color.
Custom	Applies the custom border and line formats you choose for the selected series.
Color	Select an option in the color box to change the border or line color for the selected series.
Style	Select an option in the Style box to specify the line style for a line or border.
Weight	Select an option in the Weight box to specify the line weight for a line or border. In some systems, if the line style is different than solid the line or border weight must be 1 pixel.

Markers	
Gallery	Select a chart type for the selected series or the entire chart. If a particular series is selected, a multi-type chart will be displayed in the chart area. Please note, not all chart types can be combined.
Shape	Select an option to customize the marker or point shape for a line, polar, step lines or curve chart.
Show	Lets you choose how frequent data markers are shown in the selected series.

every	For example, if you have 100 points you can choose to show the point shape every 10 markers.
Size	Changes the size of the data marker or point for a line, polar, step lines or curve chart.
Visible	Shows or hides the selected series.

Axes Tab

The table below describes the settings in the Axes Tab.

Setting	Description
Axis Selector	Choose the axis to be formatted.
Visible	Lets you show/hide the axis in the chart area. When hidden the axis will not display gridlines, tickmarks or labels.
Major Unit	Type a value in the major unit box to specify the interval of major tickmarks, gridlines (if they are displayed) in the selected axis. Labels on the selected axis will also be displayed according to the major unit setting.
Show Gridlines	Lets you show/hide gridlines at major intervals on the selected axis.
Tick mark type	Displays tick marks at the major gridlines of various shapes (cross, inside, outside, none) for the selected axis.
Minor Unit	Type a value in the minor unit box to specify the increment you want minor tickmarks and minor gridlines (if they are displayed) for the selected axis.
Show Gridlines	Lets you show/hide gridlines at minor intervals on the selected axis.
Tick mark type	Displays tick marks at the minor gridlines of various shapes (cross, inside, outside, none) for the selected axis.
Details ...	Allows you to edit the General, Scale, Labels and Grid line properties of the currently selected axis from the **Axis Selector** field above.

	Click on the screen shot for more information. 

Further information

Graphics & Context Menu

Axes Details

Axes Details

Each tab in the Axis Properties dialog allows the graphics of the selected Axis to be customized. Select the axis in the **Axis Selector** field in the **Properties: Axes Tab**.

Click on the screen shot for more information on each tab.

General Tab

The table below describes the settings in the Axes: General Tab.

Setting	Description
Axis	The axis selected in the **Properties: Axes Tab**. Either Y axis, Secondary Y axis or X axis.
Visible	Lets you show/hide the axis in the chart area. When hidden the axis will not display gridlines, tickmarks or labels.
Major unit	Type a value in the major unit box to specify the interval of major tickmarks, gridlines (if they are displayed) in the selected axis. Labels on the selected axis will also be displayed according to the major unit setting.
Show gridlines	Lets you show/hide gridlines at major intervals on the selected axis.
Tick mark type	Displays tick marks at the major gridlines of various shapes (cross, inside, outside, none) for the selected axis.
Minor unit	Type a value in the minor unit box to specify the increment you want minor tickmarks and minor gridlines (if they are displayed) for the selected axis.

Show Gridlines	Lets you show/hide gridlines at minor intervals on the selected axis.
Tick mark type	Displays tick marks at the minor gridlines of various shapes (cross, inside, outside, none) for the selected axis.

Scale Tab

The table below describes the settings in the Axes: Scale Tab.

Setting	**Description**
Minimum	Sets the smallest data value for the selected axis.
Maximum	Sets the highest data value for the selected axis.
Scale Unit	Type a number to divide numbers and reformat labels displayed in the selected axis. This option is particularly useful when you have big numbers in the selected axis. For example, if you have 10.000.000 and want to display 10 as labels in the selected axis, type 1.000.000 as the Scale unit and all axis labels will be divided by this factor.
Format	Applies a specific format to the labels in the selected axis. Select the options you want to specify a number format.
Decimal Places	Enter a number to specify the number of digits displayed to the right of the decimal point.

Labels Tab

The table below describes the settings in the Axes: Labels Tab.

Setting	**Description**
Orientation	Sets the amount of text rotation for labels in the selected axis. Use a positive number in the Degrees box to rotate labels from lower left to upper right. Use negative degrees to rotate labels from upper left to lower right. We

	recommend the use of notable (30,45,60.

Show Labels	Hides or shows labels for the selected axis.
2 Levels	Displays staggered labels. This option is particularly useful if labels overlap because of lack of space in the selected axis.
Rotate with chart	Ensures that labels will rotate according to the angles set in the 3D rotation dialog. Use this option if you want to give labels a special effect when the chart is rotated.

Title	Displays the text the axis title.

Grid Lines

The table below describes the settings in the Axes: Grid Lines Tab.

Setting	**Description**
Major gridlines	Choose a specific format for gridlines displayed at the major interval in the selected axis. Please note gridlines must be displayed in the Axis General dialog.
Color	Select an option in the color box to change the gridline color for gridlines displayed at the major interval in the selected axis.
Style	Select an option in the Style box to specify the line style for the gridlines displayed at the major interval in the selected axis.
Weight	Select an option in the Weight box to specify the line weight for gridlines displayed at the major interval in the selected axis. In some systems, if the line style is different than solid the line or border weight must be 1 pixel.

Minor	Choose a specific format for gridlines displayed at the minor interval in the

gridlines	chart area. Please note gridlines must be displayed in the Axis General dialog.
Color	Select an option in the color box to change the gridline color for gridlines displayed at the minor interval in the selected axis.
Style	Select an option in the Style box to specify the line style for the gridlines displayed at the minor interval in the selected axis.
Weight	Select an option in the Weight box to specify the line weight for gridlines displayed at the minor interval in the selected axis. In some systems, if the line style is different than solid the line or border weight must be 1 pixel.

Align with labels	Ensures that labels are displayed centered and aligned with tickmarks at the major interval in the selected axis.
Interlaced	Lets you displayed interlaced colors between a range of gridlines in the chart area. The main color is taken from the color used in the major gridlines and the secondary color is taken from the background box set in the general dialog.

Further information

Graphics & Context Menu

Properties

GNSS Spider

Add and Configure Sites

Background information

A site is a GNSS sensor connected to a Spider server. Sites can be created and configured in GNSS Spider either with the Site-Setup Wizard or manually. The Wizard will start automatically if you open a server that has no site defined yet.

Procedure

Follow these steps to add and configure Sites.

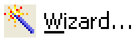
Step	Action
1	Create and configure a Site with the Site-Setup Wizard
2	Create and configure a Site manually
3	Sensor commands
4	Connect / Disconnect a Site

1: Create and configure a Site with the Site-Setup Wizard

The Site-Setup Wizard is a tool that guides you through the following stages of a site configuration:

- Setting up communication to the a sensor
- Providing site location information
- Configuration of sensor operation parameters

Follow these steps to create and configure a Site with the Site-Setup Wizard.

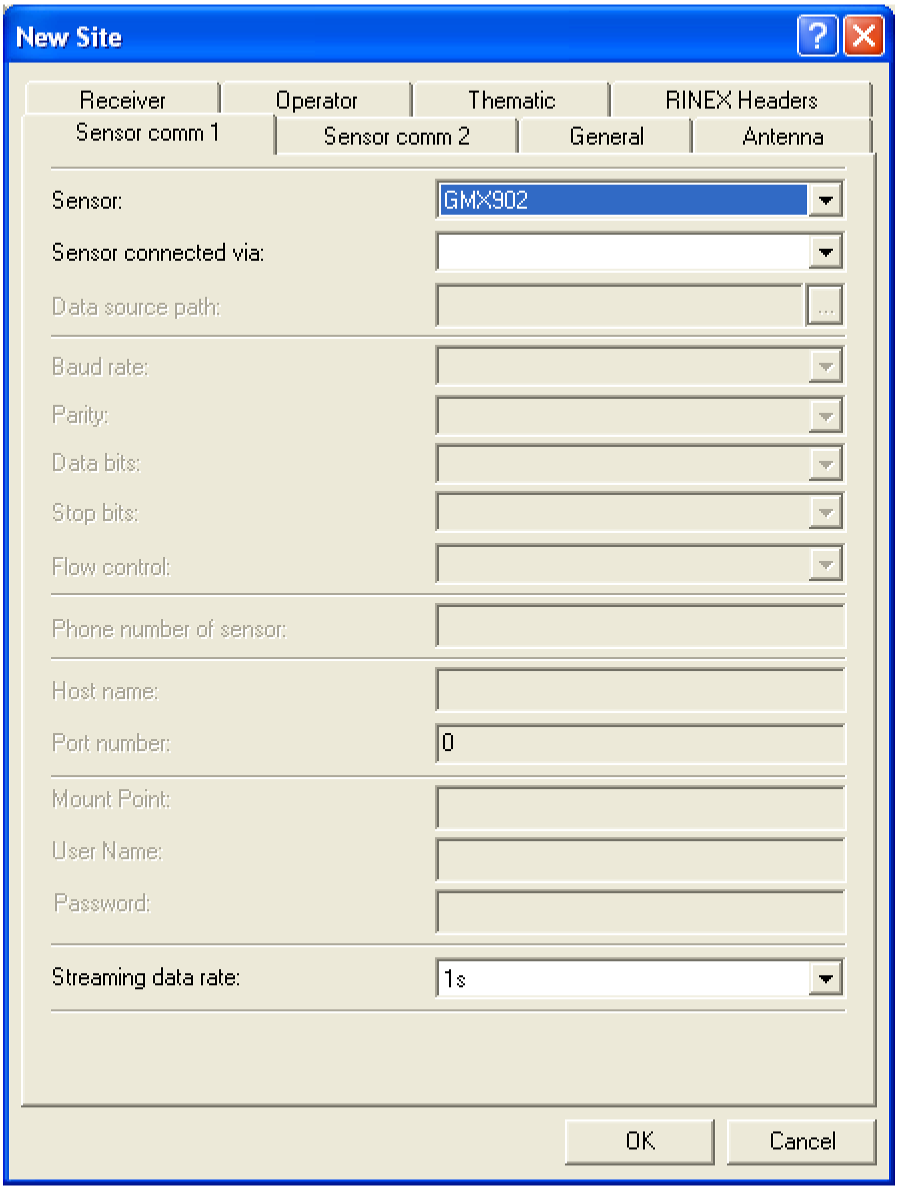
Step	Action
1	Open Local site server.
2	Click on **Tools** from the menu.
3	From the drop-down menu select  or select the corresponding toolbar button.
4	The **Wizard Welcome** dialog will be displayed. You can use **Next >** and **< Back** to navigate through the Wizard steps.
5	The **GNSS Sensor Communication** dialog will be displayed. Select the ▪ **Sensor Type** and ▪ the used communication device in the **Sensor connected via** field.
6	Click on **Next >** to connect the sensor and proceed. Note: If Spider fails to connect the sensor, the **Sensor Connection Failure** dialog appears, prior to the next step of the Wizard.
7	The **General site parameters** dialog will be displayed. Enter the ▪ **Site name**, ▪ the **Site code**, which is a unique 4 character ID and ▪ the **marker information**. The marker information is used in RINEX headers. Typically, it corresponds to Site name and code.
8	Click on **Next >** to proceed.
9	The **Antenna** dialog appears. Enter the ▪ accurate **coordinates** (alternatively, if connected to the sensor, press **From sensor** to query at least navigated coordinates), ▪ the correct **antenna type** and ▪ the height reading
10	Click on **Next >** proceed until the Site-Setup Wizard is completed.
11	The Site-Setup Wizard can also be used if connection to the sensor is not yet

	possible. In that case, finish the Wizard despite the failed connection, but remember to upload the settings once the connection can be established.

2: Create and configure a Site manually

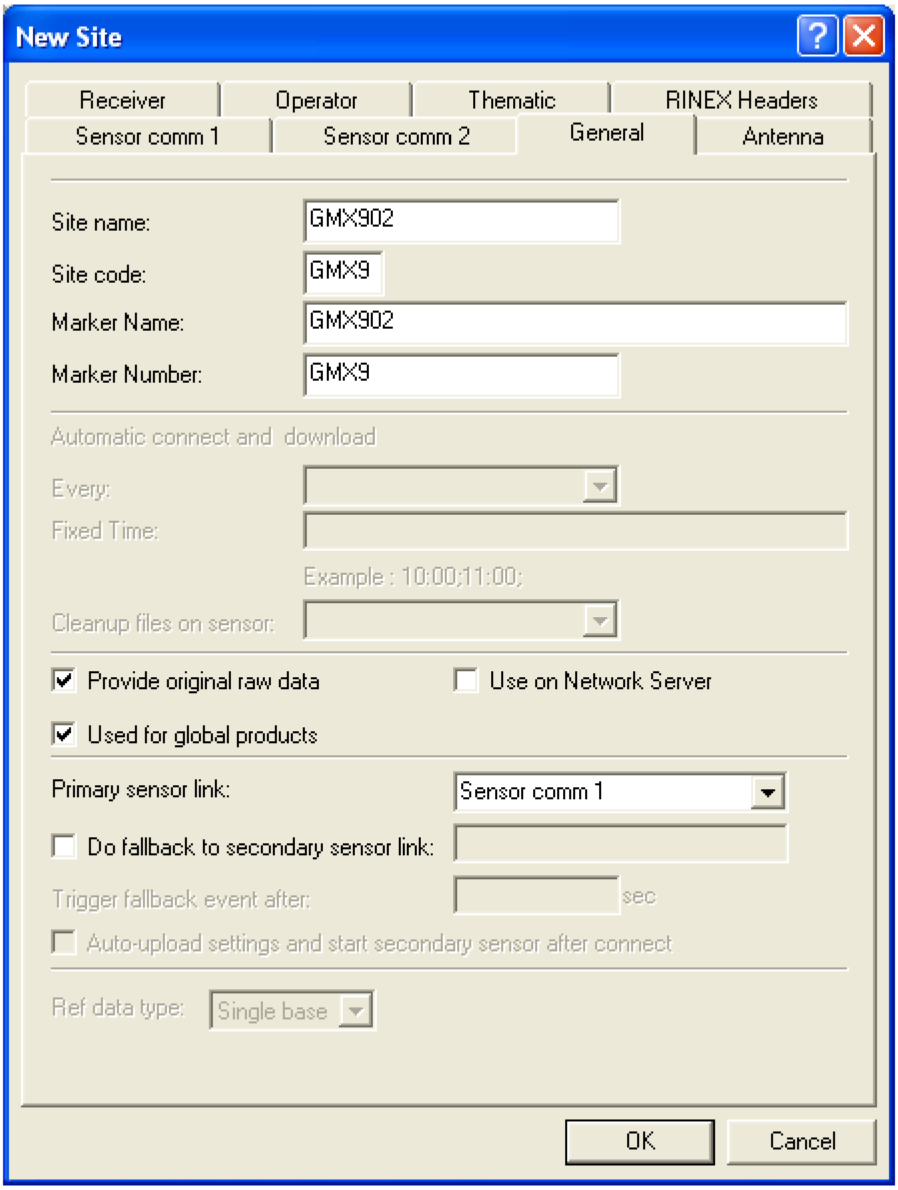
For standard setups, it is recommended to run through these basic configuration steps. Refer to the GNSS Spider Online Help for detailed information on the individual settings.

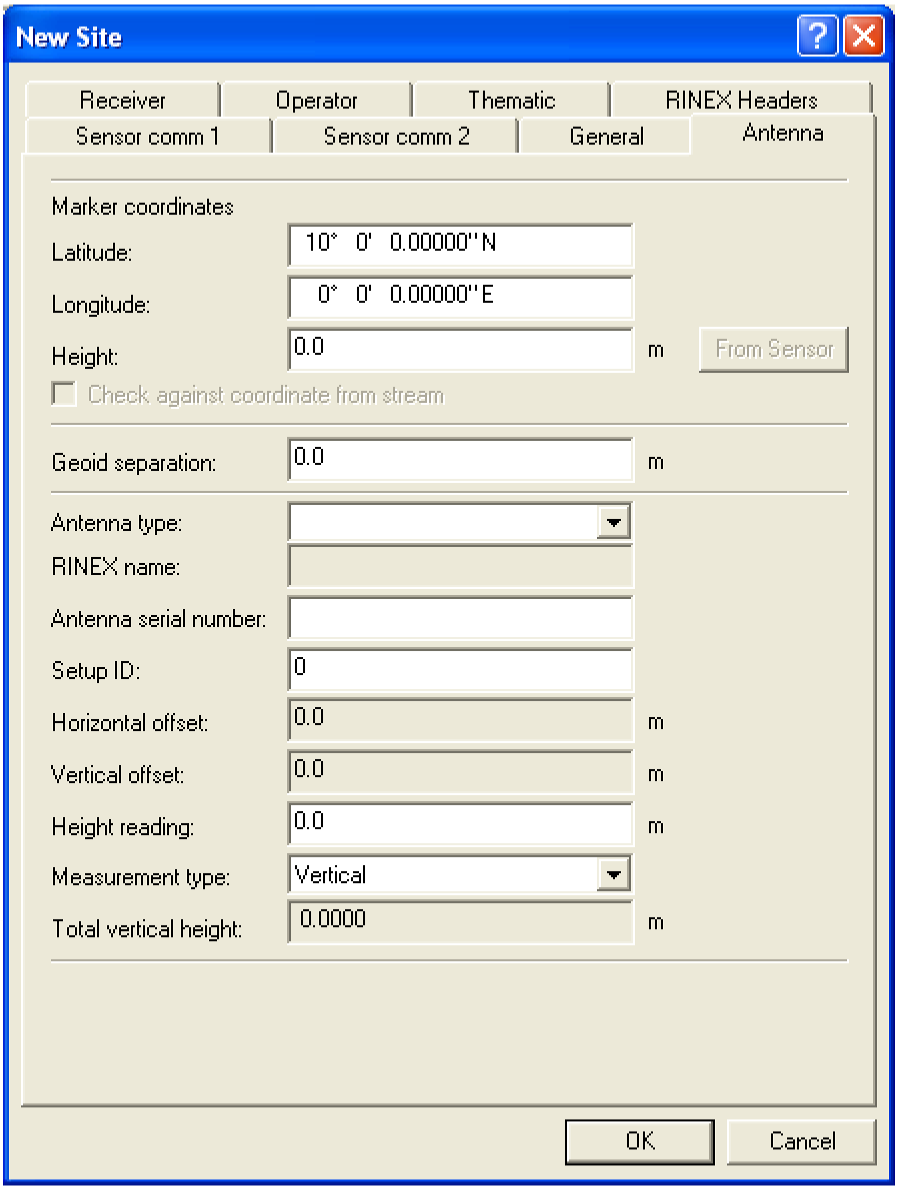
Step	Action
1	Open a server.
2	Switch with the **Tabbed-View** to the **Site tab**. 
3	Right click into the **Site tab** window, and select **New&ldots;** from the context menu.
4	The **New Site** dialog will be displayed.
5	Select the **Sensor Comm 1 tab**:

<table>
<tr>
<td></td>
<td>


Select the Sensor type and communication parameters in the field Sensor connected via.
Select the Streaming data rate.

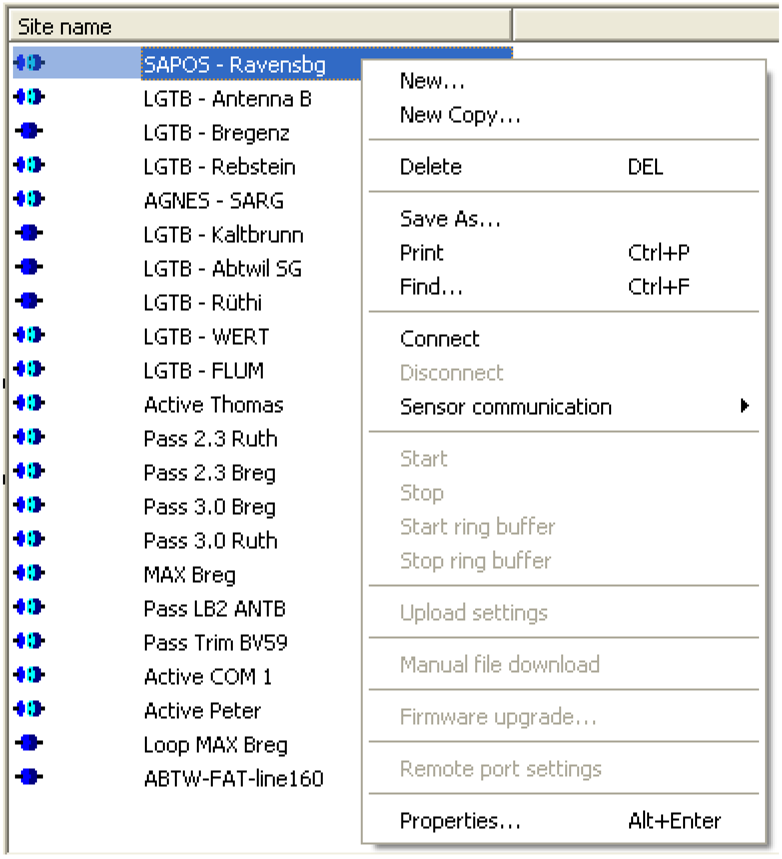
</td>
</tr>
<tr>
<td>6</td>
<td>Select the General tab:</td>
</tr>
</table>

	 ▪ Enter a **Site name** and a unique 4 character **ID**. ▪ Enter a **Marker Name** and **Marker Number**. The marker information is used for the RINEX header only. ▪ Enable **Provide original raw data** if you want to share a data stream with another Spider site server. ▪ Enable **Used for global products** for convenience when making products. This allows you to define a single product that is used for all sites.
7	Select the **Antenna tab**:

	 ▪ Enter accurate WGS84 or ITRF **coordinates**. (Select from the Menu **View, Settings...** for changing from cartesian to geodetic coordinates.) ▪ The **Geoid separation** will be added to NMEA GGA strings created by positioning products. Use the default if in doubt. ▪ Enter the correct **Antenna type**. ▪ Enter the correct **Height reading**.
8	Press **OK** to confirm or **Cancel** to abort the function.
9	Upload the settings to the sensor. (Only for active sensors).
10	Connect the sensor.

11	Start the sensor.

Sensor commands



The table below only describes the most important sensor commands.

Sensor command	**Description**
Connect	Establishes a connection between the Spider server and the selected site via the defined communication method, either serial, modem or TCP/IP connection. This command is not active in case a connection is already established. After the connection is established, you are able to upload

	settings. To prevent accidental change of communication settings it is not possible to edit these settings for a connected sensor.
Disconnect	Terminates the connection between the PC and the sensor. This command can be selected if the sensor is connected. For all real-time products, or for creating of RINEX files from a raw data stream, the sensor needs to stay connected at all times.
Start	The **Start** command can only be selected if the sensor is connected but not started yet.
Upload settings	The upload saves configuration data to the sensor and stops current product creation. The Upload settings command can only be selected if the sensor is connected. If Upload settings is sent to a sensor that is started, product creation will be stopped.

Refer to the GNSS Spider Online Help for more detailed information on the other settings.

Connect / Disconnect a Site

Follow these steps to connect or disconnect a site.

Step	Action
1	Open a server.
2	Switch with the **Tabbed-View** to the **Site tab**. 
3	Right-click on the particular item in the **Property** view on the right hand side.
4	Select **Connect** or **Disconnect** in the **Context** menu to establish communication.
5	GNSS Spider will indicate the successful connection or termination with a progress bar and a watch view message.

RT Positioning Products

Background information

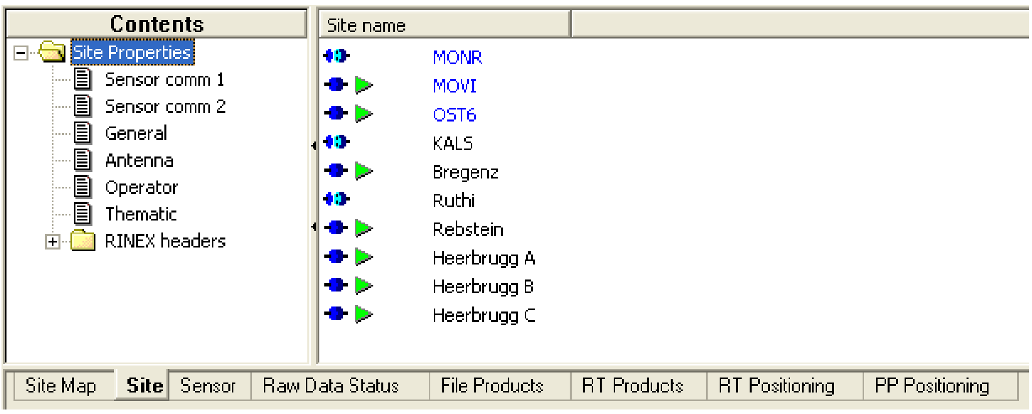
Positions are the most important output of a monitoring system. In the GNSS Spider site server it is possible to compute and distribute real-time position data streams for attached sites. One such data stream is called a **RT Positioning Product**. The positions are calculated as base lines using one site as a reference and another site as the rover. The output can be in NMEA-GGQ format (intended to be used by other software applications) or directly to the Leica GeoMoS monitoring software.

Topic contents

- Preparations
- Create and Edit RT Positioning Products
- Activate and Inactivate RT Positioning Products
- Use Spider RT Positioning Products in the GeoMoS
- Related topics
- Ambiguity Resolution Techniques

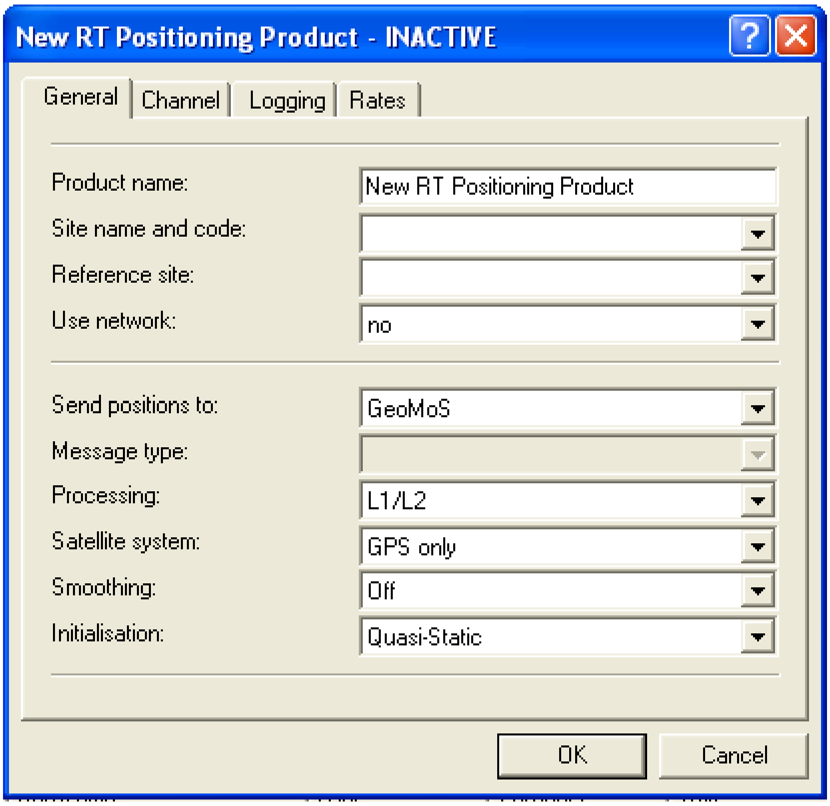
Preparations

Make sure that you have already configured two sensors. The **Site** tab should now look similar to this:

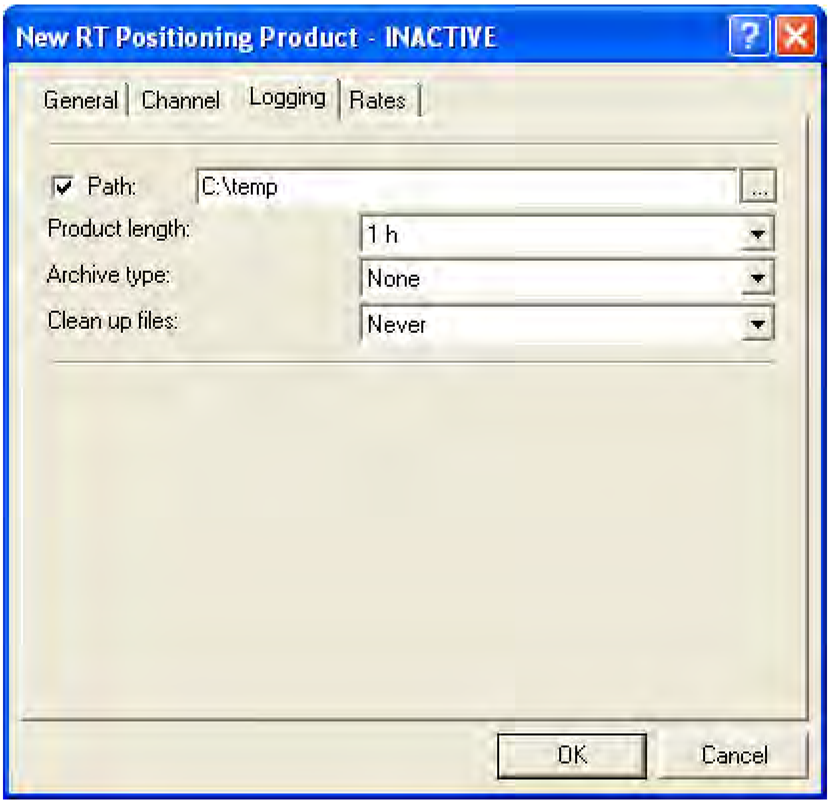


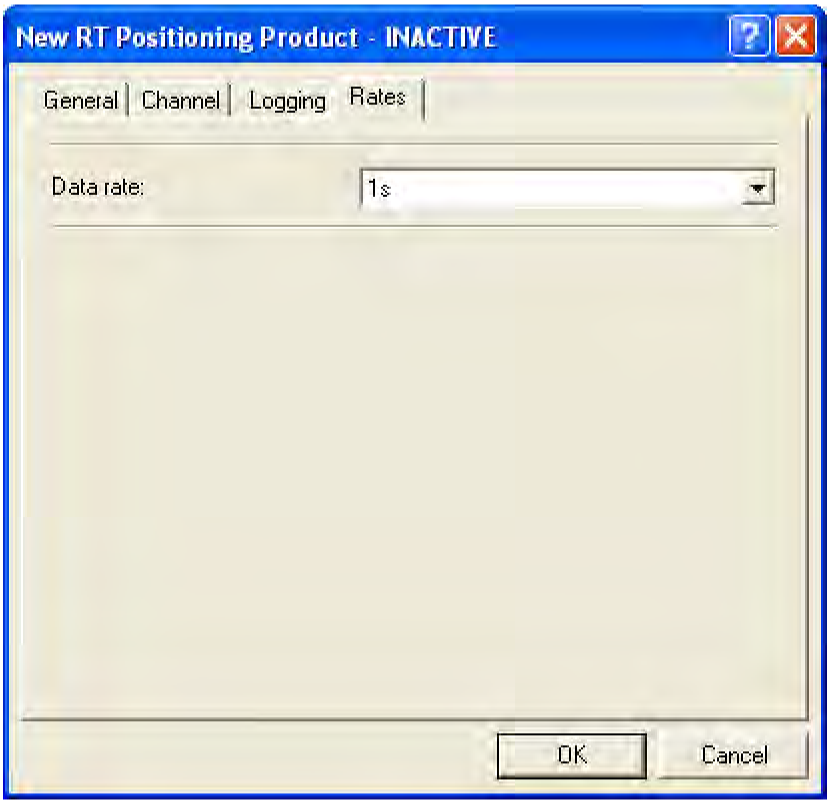
You have now done all necessary preparations in order to create a Positioning product.

Create and Edit Positioning Products

Step	Action
1	Open a server.
2	Switch with the **Tabbed-View** to the **RT Products** tab. 
3	Click into the RT Positioning Products window and select **New...** from the context menu. Now the RT Product dialog appears. Select the **General tab**:  ▪ Enter a **Product name**. Each RT Positioning Product must have a name. ▪ Select a **Site name and code**. The site that is to be monitored.

	▪ Selec t a **Reference Site**. The site that is to be used as the reference station for the baseline processing. **Note:** The rover site and reference site must be different sites (zero baselines are not permitted) and the rover site and reference site must be of the same type (real or simulated). ▪ Select the real time output: None, **GeoMoS**, Modem, COM port, TCP/IP port, NTRIP caster. ▪ Select the output format with the **Message type** field. ▪ Select L1 only or L1/L2 **Processing**. L1/L2 processing is of course recommended in case the sensor supports it. ▪ Select the **satellite system**. ▪ Select the type of Ambiguity initialisation "On Known Point", "While Moving" or "**Quasi Static**".
4	The **Channel tab** is inactive when selecting GeoMoS in the **Send Position To** field. If you select TCP/IP in the Send positions to field, you must configure the Channel tab.
5	Select the **Logging tab**:

	 ▪ Choose a **Path** to log the real time output to files (if desired). Each RT Positioning Product must have a unique path **Hint:** Hourly files will be created with the file naming convention: ProductName_YYYYMMDD_HHMMSS.rtl
6	Select the **Rates tab**:



Enter the position output **Date rate**.

Note: Calculation is done at a minimum of 1 Hz (faster rates can be selected if the streaming rate are of a corresponding rate. This will result in a higher output rate as well.)

7	Refer to the corresponding topic of the GNSS Spider Online Help for additional information on RT Positioning Products.
8	Press **OK** to confirm or **Cancel** to abort the function.
9	The RT Positioning Products will immediately become active after they have been created, as long as the configured sites are connected and started.
10	To **edit** a RT Positioning Product it is necessary to de-activate it first.

Activate and Inactivate RT Positioning Products

- The status of a product is shown by an icon:

  Active products are created as long as the configured sites are connected and started.

  Inactive products are not created, but are available for later activation.

- Change the status of a product by checking or unchecking **Active** in the product's context menu.

Use Spider RT Positioning Products in the GeoMoS

Spider RT Positioning Products must be connected in the GeoMoS Sensor Manager.

Related topics

Tour IV: Setup a RT Positioning Product.

Important Notes:

- For a RT Positioning Product to function, both sites must be **connected** and **started**
- Che   ck the **Raw Data Status** to make sure the status is **'Receiving data'**
- Either the reference and/or the rover data stream must contain **ephemeris data**. Hence it is not possible to make a RT Positioning Product using two Passive RTCM 2.3 sites
- No position will be calculated if no data are received from the rover station &endash; a null GGQ string will be output
- A navigated position will be calculated if no reference data is available
- **Relative latency** will affect the accuracy of the results. The latency is shown in the Raw Data Status tab.

Ambiguity Resolution Techniques

- **While Moving** ambiguity resolution technique (also knows as "on-the-fly" or OTF) is suitable for receivers with high dynamics. Use for sites that expected to move rapidly

or far from their initial position. The reliability is not as high as with the other approaches.

- **On Known Point** ambiguity resolution is more reliable but requires that the reference station and rover station have highly accurate coordinates. If the sites are moving then the coordinates must be updated in the site configuration because inaccurate coordinates will prevent GNSS Spider from resolving the ambiguities.
- **Quasi static** is a combination of the While Moving and On Known Point approaches. The site coordinates are used to aid the ambiguity resolution, but they do not need to be very accurately known (a few decimeters or a meter is sufficient). Use for sites that are expected to move but not very far or fast.
- Wrong fixes are more likely with While Moving initialization, especially for long baselines. A wrong ambiguity fix will be seen as a jump in the coordinates.

PP Positioning Products

Background information

PP Positioning Products are GNSS baselines that are computed using logged RINEX file products. PP Positioning Products enable accurate position computation also in extremely difficult GNSS environments, caused for example by severe obstructions, where real-time processing may fail or gives unsatisfying results.

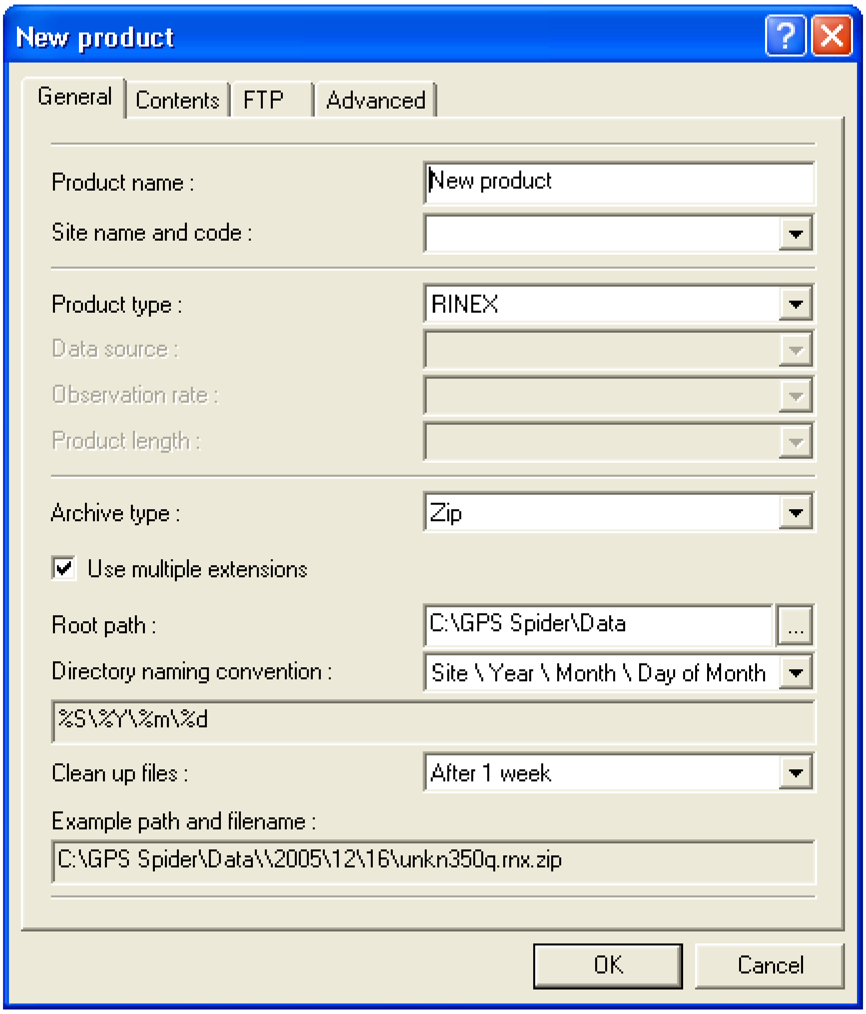
Topic contents

Create File Products

A file product is a recorded data set of GNSS raw observations. Usually they are stored in RINEX format, but it is also possible in LEICA MDB format. Quality files are also considered to be file products. File Products are needed for archiving of the raw data and GNSS monitoring using PP Positioning Products.

Follow these steps to create a File Product.

Step	Action
1	Open a server.
2	Switch with the **Tabbed-View** to the **File Products** tab.
3	Click into the File Products window and select **New...** from the context menu.
4	The **New product** dialog will be displayed.



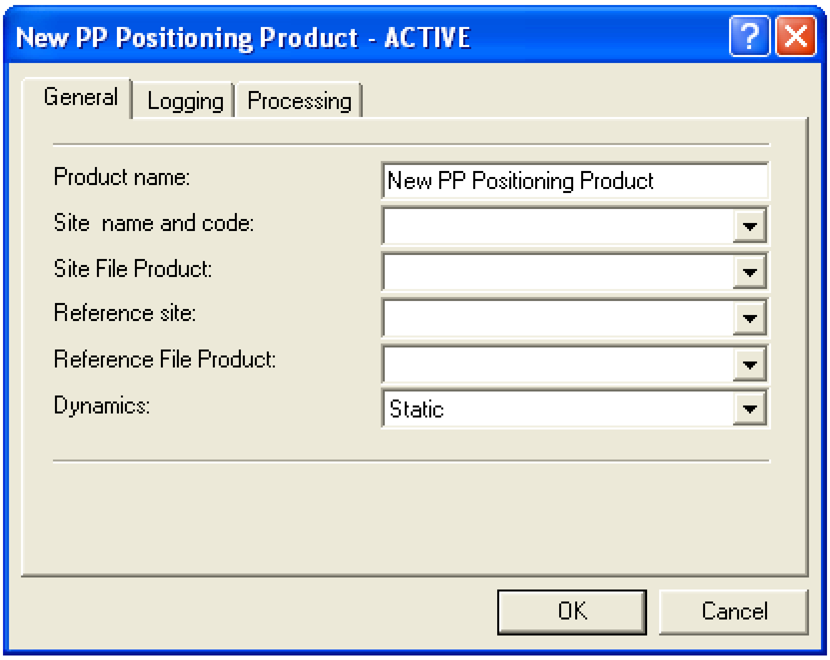
- Enter a **Product name**. Each File Product must have a name.
- Select the **Site name** for which you want to generate a product. If you select **All real data sites** file products will be created for all sites which are checked for global products.
- PP Products works with **RINEX** file products with either no compression, Zip or GZip only.

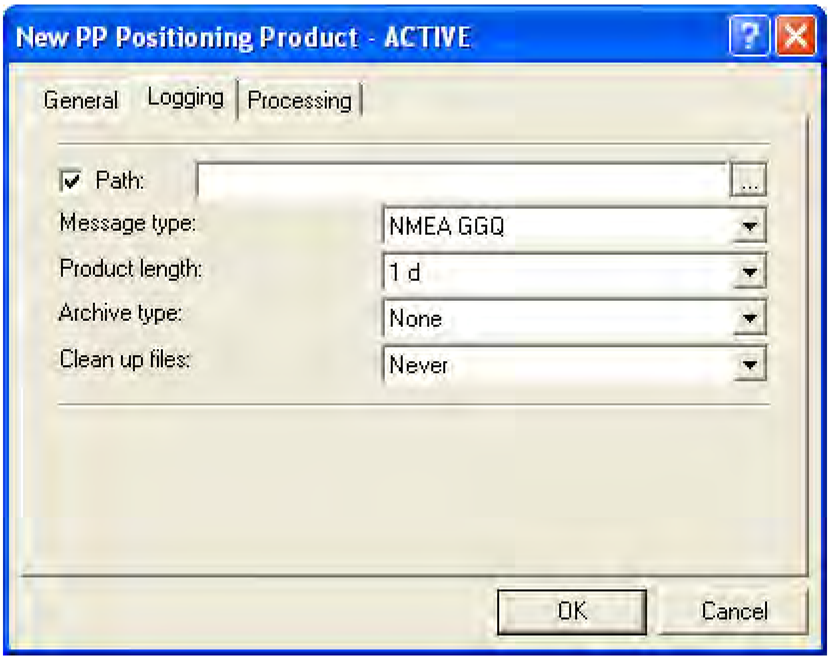
5	Refer to the corresponding topic of the GNSS Spider Online Help for additional information on File Products.
6	Press **OK** to confirm or **Cancel** to abort the function.
7	The File Products will immediately become active after they have been created. **Note:** All File Products will be created before PP Positioning Products are

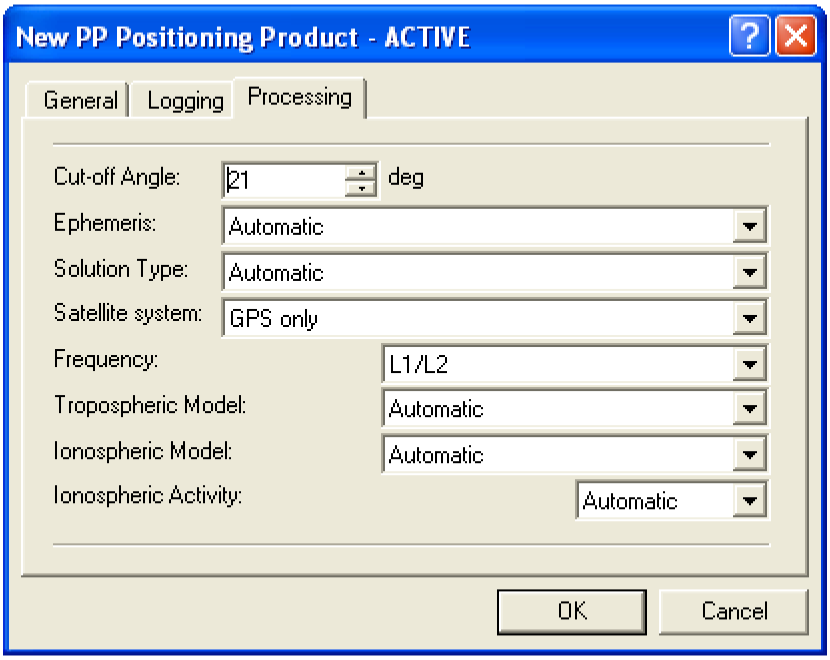
	started for performance reasons.

Create and Edit PP Positioning Products

To create and Edit a PP Positioning Product follow these steps.

Step	Action
1	Open a server.
2	Switch with the **Tabbed-View** to the **PP Products** tab. 
3	Click into the PP Positioning Products window and select **New&ldots;** from the context menu.
4	The **New PP Product General tab** will be displayed.  ▪ Enter a **Product name**. The name must be unique for each PP Positioning Product.

	▪ Select the name of the "rover" or "monitoring" site. Site name and code and Reference site must be different. ▪ Select the Site File Product, the RINEX file product that is activated for the rover site. The length of the file product for the rover site must be equal to the length of the reference file product. ▪ Select the name of the reference site. ▪ Select a Reference File Product, the RINEX file product that is activated for the reference site. The length of the file product for the rover site must be equal to the length of the reference file product.
5	Select the **Logging tab**:  ▪ Choose a path to log the files (if desired).
6	Select the **Processing tab**:

<table>
<tr><td></td><td>


Select the satellite system. This parameter defines whether GPS only data or combined GPS/GLONASS data is to be used for processing. The default setting Automatic will automatically use the data available for reference and rover.
Select the Frequency. Default setting is Automatic. When chosen, the best frequency or combination of frequencies for the final solution will be selected. If dual-frequency data is available, both frequencies will typically be used.
The same processing parameters are used as the defaults in Leica LGO.

Note: Refer to the corresponding topic of the GNSS Spider Online Help for additional information on PP Positioning Products.
</td></tr>
<tr><td>7</td><td>Press OK to confirm or Cancel to abort the function.</td></tr>
<tr><td>8</td><td>The PP Positioning Products will immediately become active after they have been created.</td></tr>
</table>

Logging of Results

- The results are automatically recorded in a special SQL database called SpiderPositioning.

- The results are also recorded in ASCII files with a roll over of 1 day and with the file naming convention: **`ProductName_YYYYMMDD.rtl`** in the folder **`C:\GPS Spider\Data\PostProcessing\NMEA`**

- PPI files with the full processing results are also created and stored in the folder: **`C:\GPS Spider\Data\PostProcessing\PPI`**

Note: The PPI files have an automatic cleanup of 1 week.

Important Notes:

- For a PP Positioning Product to function, both sites must be **connected** and **started** and the File Products must be **activated**
- One or both of the File Products must contain **ephemeris data**.
- File Products of at least 10 minutes must be used if processing L1 only data
- If the File Products are split (because a site is disconnected and re-connected) then only the first one will be processed
- PP Positioning Products will potentially use a lot of CPU and hard disk. Therefore the PP Positioning Products are done sequentially (one at a time) and only once creation of all file products has finished.
- Currently only uncompressed file products and file products compressed by Zip and GZip are supported.
- If the file product is from streaming data and the site is stopped and re-started then multiple file products will be created where there would normally be one. One of the last products to be created should be used (the file product at the normal file product rollover).

Technical Information

Messages

The following messages may be generated by the system. See the Description/Comment for information on what each message means and, if applicable, how the issue can be resolved.

Some messages are from previous versions of GeoMoS and are no longer supported. These messages are still retained in the database and as such will be shown in the Message Configurator.

Message ID	Message	Priority	Type	Description / Comment
1	System failure	Warning	1	Not supported
2	Power failure !	Warning	1	You must have connected a UPS (uninterrupted power supply) to the PC where GeoMoS Monitor is running. Most UPS application can run a external application if the power is interrupted. In the BIN directory of the GeoMoS installation a small application (UPS_Alarm.exe) that will produce this message.
3	Burglary !	Warning	1	GeoMoS Monitor will support a digital Input / Output card. It is possible to connect a electronic security system to one of this input channel. (Link:http://www.icpdas.com/products/Products-list.htm)
4	Short time limit check level 1 exceeded !	Warning	1	The observation exceeded the specified Short Time limit level 1 set in the limit class.
5	Long time limit check level 1 exceeded !	Warning	1	The observation exceeded the specified Long Time limit level 1 set in the limit class.

6	Point not found !	Message	2	If the Total Station cannot measure to a prism (atmospheric fluctuation, no visibility to the prism) it will produce this message.
7	Point out of tolerance !	Message	2	If the multiple measurement function (see TPS Properties: Measurements) is activated the system will check the measurements if they are inside of the defined standard deviation. The function will check horizontal angle, vertical angle and the slope distance.
8	Point does not exist or computed distance to the point is too long !	Message	2	If the difference between the Null Coordinate and the Current Coordinate is to big the system will react with this message. In such a case it helps to overwrite the Null Coordinate (Point Editor -> right mouse button -> Set Null Measurement).
9	Point blunder check failed !	Message	2	If the coordinate difference between the last measurement and the actual measurement is more then the limit you defined for the Blunder tolerance. See TPS Properties: Measurements.
10	Theodolite not defined !	Message	2	Not supported
11	No communication with sensor !	Message	2	The communication is not possible. Check cable, power and communication parameter. If GeoMoS cannot communicate with GNSS Spider or GNSS Spider does not send results for a particular RT Positioning Products the system will react with this message. If GeoMoS cannot connect to the GNSS Spider Positioning database the system will react with this message.
12	Positioning failure !	Message	2	The Total Station cannot reach the angle position. Instable setup or vibration in the area of the Total Station can be the reason for this problem.

13	Slope distance not measured !	Message	2	Not supported
14	Communication lost !	Warning	1	Not supported
15	Point not in profile	Information	3	This is only an information message. In the point editor you have not linked a profile to the monitoring point. In this case the system will work with a virtual profile direction. Profile direction = Measurement direction (Instrument Setup minus Monitoring point)
16				
17	Point group measurement finished	Message	2	This is only an information message. The measurement of a point group cycle is finished.
18				
19				
20	No meteo correction!	Message	2	Not supported
21	No reference PPM correction!	Message	2	Not supported
22	No projection scale correction	Message	2	Not supported
23	GNSS coordinates not converted !	Message	2	Occurs if the GNSS coordinates cannot be converted from the WGS1984 coordinate system into the local coordinate system. Check in the Options dialog the coordinate system.
24	Station coordinates not	Message	2	Not supported

	computed !			
25	Velocity could not be computed !	Message	2	Not supported
26	Displacement computation out of range !	Message	2	Not supported
27	Not enough space on disk !	Message	2	The hard disk space is too low for GeoMoS to store new measurements and results to the database.
28	Communication problem !	Message	2	Implemented in GeoMoS Monitor. Occurs if the message 11 "No communication with sensor" is produced more than 5 times within 60 minutes.
29	Data backlog!	Message	2	Not supported
30	Compensator out of range	Message	2	In the Option Dialog of GeoMoS Monitor it is possible to activate the compensator check. If the tolerance is exceeded the system will produce this message.
31	Nivel inclination measurement out of range !	Message	2	Not supported
32	Not all coordinate types in database !	Message	2	Not supported
33	Coordinate calculation failed !	Message	2	Not supported
34	Regression limit check level 1 exceeded !	Warning	1	The observation exceeded the specified Regression limit level 1 set in the limit class.
35	Absolute limit	Warning	1	The observation exceeded the specified

	check level 1 exceeded !			Absolute limit level 1 set in the limit class.
36	Reference group out of tolerance !	Warning	1	The precision of the reference group is below the specified limits.
37	Short time limit check failed !	Message	2	The short time limit could not be calculated. This usually occurs when there is insufficient data.
38	Long time limit check failed !	Message	2	The long time limit could not be calculated. This usually occurs when there is insufficient data.
39	Absolute limit check failed !	Message	2	The short time limit could not be calculated. This usually occurs when there is no Null Value set in the Null Measurements Editor.
40	Regression limit check failed !	Message	2	The regression limit could not be calculated. This usually occurs when there is insufficient data.
41	Spider Post Processing not configured	Message	2	Not supported
42	Measurement Process Stopped	Information	3	This message is given when the user stops the measurement.
43	No results for Spider Post Processing available	Message	2	Not supported
44	Null measurement not defined !	Message	2	The Null Value has not been set in the Null Measurements Editor.
45	Observation type not supported !	Message	2	An observation type was received from the sensor that is not supported.
46	Not enough	Message	2	No enough measurements are available to be

	measurements for limit check			able to compute the limit check.
47	GNSS data received but of poor quality	Message	2	Data is being received from the GNSS sensor but the quality is not equal to that set in the Sensor Settings.
48	Current position of GNSS differs greatly from null coordinate !	Message	2	There is a very big difference between the coordinate received from the GNSS sensor and the null measurement.
49	Target point identical with station point	Message	2	The Total Station control point and the target point being measured are the same.
50	Wrong coordinates or coordinate system invalid !	Message	2	The GNSS coordinate could not be transformed possibly due to an invalid coordinate or because the Coordinate System is not set correctly.
51	Not enough measurements for reference group calculation	Message	2	Not enough target points were measured for the reference group (FreeStation, DistanceIntersection, PPM, VzCorrection or OrientationOnly) to be calculated. See the point group properties in the Point Group Editor.
52	Short time limit check level 2 exceeded !	Warning	1	The observation exceeded the specified Short Time limit level 2 set in the limit class.
53	Short time limit check level 3 exceeded !	Warning	1	The observation exceeded the specified Short Time limit level 3 set in the limit class.
54	Long time limit check level 2 exceeded !	Warning	1	The observation exceeded the specified Long Time limit level 2 set in the limit class.
55	Long time limit check level 3	Warning	1	The observation exceeded the specified Long Time limit level 3 set in the limit class.

	exceeded !			
56	Absolute limit check level 2 exceeded !	Warning	1	The observation exceeded the specified Absolute limit level 2 set in the limit class.
57	Absolute limit check level 3 exceeded !	Warning	1	The observation exceeded the specified Absolute limit level 3 set in the limit class.
58	Regression limit check level 2 exceeded !	Warning	1	The observation exceeded the specified Regression limit level 2 set in the limit class.
59	Regression limit check level 3 exceeded !	Warning	1	The observation exceeded the specified Regression limit level 3 set in the limit class.
60	FTP Upload done	Message	2	Not supported
61	FTP Download done	Message	2	Not supported
62	FTP Upload failed!	Message	2	Not supported
63	FTP Download failed!	Message	2	Not supported
64	Measurement failed!	Warning	1	If the sensor type level does not send a result the system will react with this message. To avoid this message the switchbox is recommended.
65	Not enough measurements for GNSS average	Warning	1	The number of results available to compute a GNSS average does not correspond to the settings in the GNSS Properties dialog.
66	No GNSS measurement	Warning	1	No results of the configured GNSS data source are available to update the Total Station

	found to update TPS station			coordinates. See the GNSS Update in the TPS Properties.
67	Old GNSS measurement used to update TPS station	Warning	1	The GNSS coordinate that is used to update the Total Station coordinate was measured more than 12 hours before.
68	No GNSS Spider PP Product results within the expected time range	Message	2	If no PP Positioning Product is available within two times of the product length the system will react with this message.
69	Limit checks are not supported by the current software license or attached dongle	Information	3	If the customer wants to use the limit check computation he needs to purchase Monitor Option 2.
70	Reference group calculations are not supported by the current software license or attached dongle	Information	3	If the customer wants to use the totals station computation he needs to purchase Monitor Option 1.
71	You have more active sensors than what the current software license or attached	Information	3	If the customer wants to use more sensors he needs to purchase additional sensor licenses.

	dongle supports			
72	Your GeoMoS software maintenance key will expire within the next days!	Information	3	Occurs if the software maintenance key expires in 30 days. The message is shown once a day. The software maintenance key is related to a valid Customer Care Package (CCP). After the software maintenance key is expired it is not possible to update the GeoMoS software with newer versions.
73	Measurement out of range	Warning	1	The measurement of the geotechnical sensor exceeds set minimum / maximum limits.
74	No measurements available	Warning	1	Occurs if no new result is available in the Campbell datalogger table between the last the readout time and the current readout time.
75	Measurement Process Started	Information	3	This message is given when the user starts the measurement.
76	Error in formula	Warning	1	In the Virtual Sensor Editor of GeoMoS Monitor it is possible to enter a formula for virtual sensors. On OK the formula will be checked for syntax errors. Occurs if a formula with a syntax error is included in the measurement cycle.
77	Formula refers to a invalid point, sensor or observation type	Warning	1	Occurs if the formula refers to an alias with an invalid point.
78	Measurement missing to evaluate formula	Warning	1	The computation could not be executed because a missing measurement value. This can happen if e.g. the Max Age [h] was reached. The Max Age defines the expiry date of the real sensor data used in an alias.
79	Computation is not supported by the current	Warning	1	If the customer wants to use virtual sensor computation he needs to purchase Monitor Option 1.

	software license or attached dongle			
80	Division by zero while evaluating the formula	Warning	1	Syntax error in the virtual sensor formula.
81	Result of formula is out of range	Warning	1	The result of the virtual sensor exceeds set minimum / maximum limits.
82	Failed to send E-Mail	Warning	1	Occurs if the E-Mail address is wrong or the configured SMTP cannot be reached.
83	Failed to send SMS over Leica GFU	Warning	1	Occurs if the mobile number, pin code, port or baud rate is wrong.
84	Failed to send SMS over aspsms.com	Warning	1	Occurs if the aspsms.com server cannot be reached.
85	Failed to authenticate at aspsms.com	Warning	1	Occurs if the authentification fails caused by a wrong user an/or password. The internet connection exists.
86	Name of table changed	Information	3	Not supported
87	Table no longer exists	Warning	1	Occurs if the Campbell datalogger program was modified without adapting the current configuration in the GeoMoS Sensor Manager. GeoMoS cannot read in any new measurements from this Campbell datalogger table because the table is deleted.

88	Table has now additional fields	Information	3	Occurs if the Campbell datalogger program was modified without adapting the current configuration in the GeoMoS Sensor Manager. The new fields have been added at the end of the table on the datalogger. To read in any of these new measurements it is required to re-configure the table.
89	Existing fields of table have been change	Warning	1	Occurs if the Campbell datalogger program was modified without adapting the current configuration in the GeoMoS Sensor Manager. GeoMoS cannot read in any new measurements from this Campbell datalogger table because the configuration is inconsistent.
90	Access to Webcam failed	Warning	1	The access to the webcam failed. Occurs if the Service is not started or the access to the IP address could not be established. To check the service please go to: Start - Settings - Control panel - Administrative Tools - Services - GeoMoS.WebCam.IpCamService
91	Too many pictures in database	Warning	1	This message is given when the total amount of webcam images is reached. Default storage size is 1GB.
92	No connection to service	Warning	1	The access to the GeoMoS Web FTP Push failed. To check the service please go to: Start - Settings - Control panel - Administrative Tools - Services - GeoMoS.Ftp.PushService
93	Configuration data push to GeoMoS Web initiated	Information	3	The message is given when the automatic measurement cycle is started. Due possible system configuration changes it is required to transfer the latest configuration to GeoMoS Web.
94	Measurement data push to	Information	3	The message is given when the defined action "Data push to GeoMoS Web" was successful.

	GeoMoS Web initiated			
95	Data push reset because of GeoMoS project switch	Information	3	Not supported
96	Configuration data successfully pushed to GeoMoS Web	Information	3	Not supported
97	Measurement data successfully pushed to GeoMoS Web	Information	3	Not supported
98	Data push login failed	Information	3	Not supported
99	Connection to GeoMoS Web server established	Information	3	Not supported
100	Connection to GeoMoS Web server failed	Information	3	Not supported
101	Data push to GeoMoS Web failed	Information	3	Not supported
102	Export to GeoMoS Adjustment succeeded	Information	3	This message is given when the defined Action "Export Service to GeoMoS Adjustment" was successful.
103	Export to GeoMoS	Warning	1	This message is given when the Service is not started or the software license does not support

	Adjustment failed			the option GeoMoS Monitor Option 3. To check the service please go to: Start - Settings - Control panel - Administrative Tools - Services - GeoMoS.Adjustment.Export.Service
104	Sensor not leveled	Warning	1	Occurs if the sensor (e.g. Leica DNA or Leica Sprinter) is not leveled up with the electronic bubble.
105	Export Service to GeoMoS Adjustment is not supported by the current software license or attached dongle.	Information	3	If the customer wants to use the Export Service to GeoMoS Adjustment he needs to purchase Monitor Option 3.
106	Failed to send SMS via ComBox.	Warning	1	Occurs if

Coordinate Types

GeoMoS uses several different coordinates types as listed in the table below. Each point has types 1 through 4 and instrument points have type 5.

Number	Coordinate Type	Overwritten	Used
1	Null	Only manually using the Point Editor.	Reference for calculating displacement
2	Reference	Manually or when importing points.	To calculate PPM, VzCorrections corrections (target coordinates).
3	Current	Manually or by measuring any point group.	To calculate displacement, limit checks, blunder checks.
4	Scan	Manually or by measuring a Normal group.	Target coordinates used when positioning the telescope and search for the target.
5	Setup	Manually or by calculating a Free Station, Distance Intersection or GNSS Update.	Instrument coordinates used when positioning the telescope.

The only case where the scan and the current coordinates are not equal is the 1D monitoring (distance only calculation).

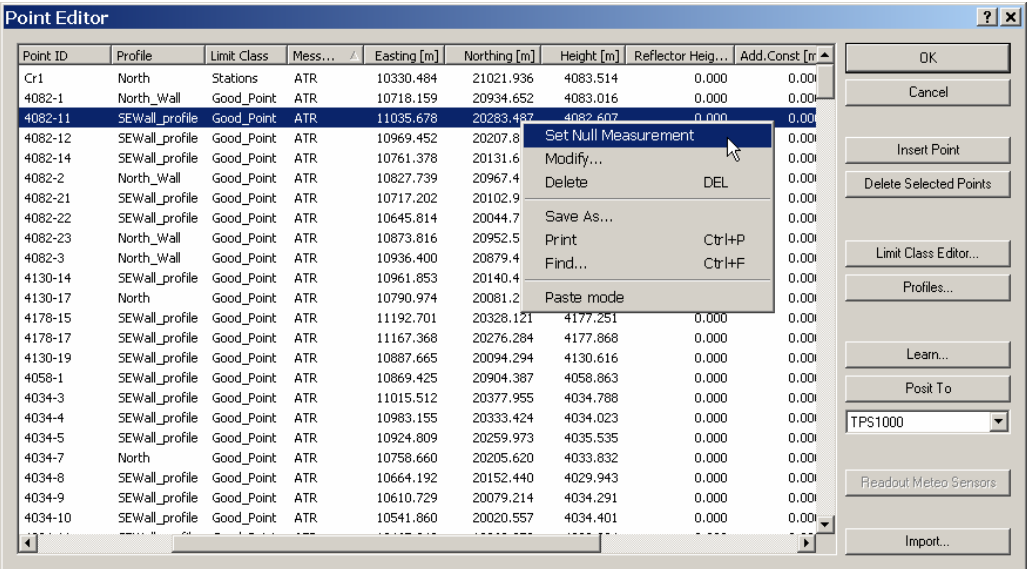
Note:

If the message "Point does not exist or computed distance to the point is too long !" is given when measuring to a point, then the Null coordinate and the current coordinate are very different. This problem can occur if the coordinates of the point are changed at any time except for immediately after the point was inserted into the Point Editor and before the dialog was closed with OK.

Warning:

Changing the Null coordinate will cause a jump in the calculated displacements.

To manually set all coordinate types, including the Null coordinate to equal the current coordinates, use the Set Null Measurement context menu option in the Point Editor as shown in the diagram below.



Point Group Types

GeoMoS uses several different point group types as listed in the table below.

Number	Priority	Point Group Type	Description	Point Type Used
1	low	Normal	Used for to measure monitoring points	Monitoring
9	high	Orientation	Used to correct the sensor orientation of Total Stations	Control
8	high	PPM	Used to estimate the atmospheric PPM correction of Total Stations	Control
5	high	Free Station	Used to estimate Total Station coordinates and orientation of Total Stations	Control
6	high	Distance Intersection	Used to estimate Total Station coordinates and orientation of Total Stations	Control
7	high	Vz Correction	Used to estimate vertical circle correction of Total Stations	Control
2	middle	Special	Used to measure critical monitoring points	Monitoring

Related topics:

Measurement Priority

Meteo Corrections

Two different types of correction can be used to account for scale (PPM) errors in the measured slope distances from the total station:

- corrections calculated from distance measurements to control points (PPM Point Groups) and
- corrections calculated from measured meteorological values (temperature and pressure).

The meteo model that is used is configured in the TPS Properties: Calculations in the Sensor Location Editor. Both techniques have advantages and disadvantages as listed in the table below.

	Meteo Sensor(s)	**Reference Distances**
Advantage ✓	▪ Can be used if instrument control point is unstable ▪ Sensors are not very expensive ▪ Additional data is available for analysis	▪ Generally gives more accurate PPM values than meteo sensors ▪ Need good control any way for orientation
Disadvantage ✗	▪ May give erroneous results if not sited properly (needs be in shade, protected from snow) ▪ Additional sensor(s) and cable(s) required ▪ A single sensor will not be able to pick up directional variations in the atmosphere	▪ Need control and instrument control point with very well known and stable coordinates ▪ Control may be in a different area to the monitoring points (correction not representative) ▪ May not always be able to observe reference points to to rain, snow, dust, obstructions etc.

Background information

The PPM is used to account for scale errors in the measured slope distances. The scale errors are caused by changes in the atmosphere (temperature, pressure and humidity).

The following table shows for different distances (50m, 100m and 1000m) the effects in the measured slope distance in case the PPM is not applied:

Temperature	**Reference distance in standard atmosphere**		
12°C / 1013mBar	50.0000 m	100.0000 m	1000.0000 m
-40°C	49.9969 m	99.9938 m	999.9381 m
-30°C	49.9976 m	99.9952 m	999.9523 m
-20°C	49.9983 m	99.9965 m	999.9653 m
-10°C	49.9989 m	99.9977 m	999.9774 m
0°C	49.9994 m	99.9987 m	999.9885 m
10°C	49.9999 m	99.9999 m	999.9989 m
20°C	50.0004 m	100.0009 m	1000.0086 m
30°C	50.0009 m	100.0017 m	1000.0176 m
40°C	50.0013 m	100.0026 m	1000.0260 m
50°C	50.0017 m	100.0034 m	1000.0339 m
60°C	50.0021 m	100.0041 m	1000.0414 m

Important:
For **long slope distances** it is important to account for scale (PPM) errors, because the scale error is much bigger than the EDM precision.

Signal Scan Measurement Mode

When to use

Use the measurement mode Signal Scan

- to measure the 3D coordinates of a prism that is beyond the range of the Automatic Target Recognition (ATR).

Background Information

To be able to determine the three dimensional position of a prism that is beyond the range of Automatic Target Recognition (ATR), a special measurement mode known as Signal Scan has been implemented. Signal scanning uses the return strength of the EDM to centre on the prism so that angle measurements may be recorded with some degree of accuracy. Signal scanning is inherently slower and less accurate than ATR measurement.

Two signal scan measurement modes are available:

- Signal Scan (IR)
- Signal Scan (LO)

These modes are based on the two types of EDM that are used in Leica total stations (infrared IR and redlaser LO). Each type of each has certain characteristics that make it more or less suitable for signal scanning.

Signal Scan Requirements

GeoMoS Monitor - Configuration - Sensor Location Editor - TPS Properties: Calculations configured for 3D Monitoring:

- Coordinate calculation set to **Full measurement**
- Distance Reduction set to **Using Vertical Angles**

Orientation correction is determined with the point group "Free Station" or "Orientation Only" Control point coordinates are determined with the point group "Free Station" or "Distance Intersection", if required.

Signal Scan vs. Distance Only Measurement Mode

The signal scan measurement mode only makes sense if the distance to a point is **outside of the ATR** range. Signal scanning is inherently slower and less accurate than ATR measurement.

The distance only measurement mode only makes sense if the distance to a point is **outside of the ATR** range and the customer is only interested in Longitudinal displacements, slope distance measurements and ppm values.

	Signal Scan (SignalScan IR/LO)	**Distance Only (DistanceOnly IR/LO)**
Advantage	▪ Determines the three dimensional position of a prism. ▪ Angles are recorded as well but will be very inaccurate.	▪ The slope distance is measured high-precise. ▪ Detects movements only in the direction of the distance measurement. ▪ Measures only the slope distances using the EDM. A single measurement is very fast. ▪ Accuracy is based on EDM. ▪ Longitudinal displacement, Slope distance and PPM can be used for analysis.
Disadvantage	▪ Depends on the atmospheric conditions ▪ Over very long distances (several kilometers) signal scan is not practical because the angle measurements become very inaccurate. ▪ A single signal scan to one prism may take between 30 seconds and two minutes or even longer under certain atmospheric conditions.	▪ No angles are measured. ▪ Requires a special monitoring setup geometry to be able to detect movements. ▪ The profile direction should be similar to the measurement direction of the instrument, because of the special calculation method. ▪ Transverse and Height displacement cannot be used for analysis. ▪ Operation of system and analysis of data is more complicated in a 1D than in a normal 3D system. ▪ Depends on the atmospheric conditions. The atmospheric corrections should be

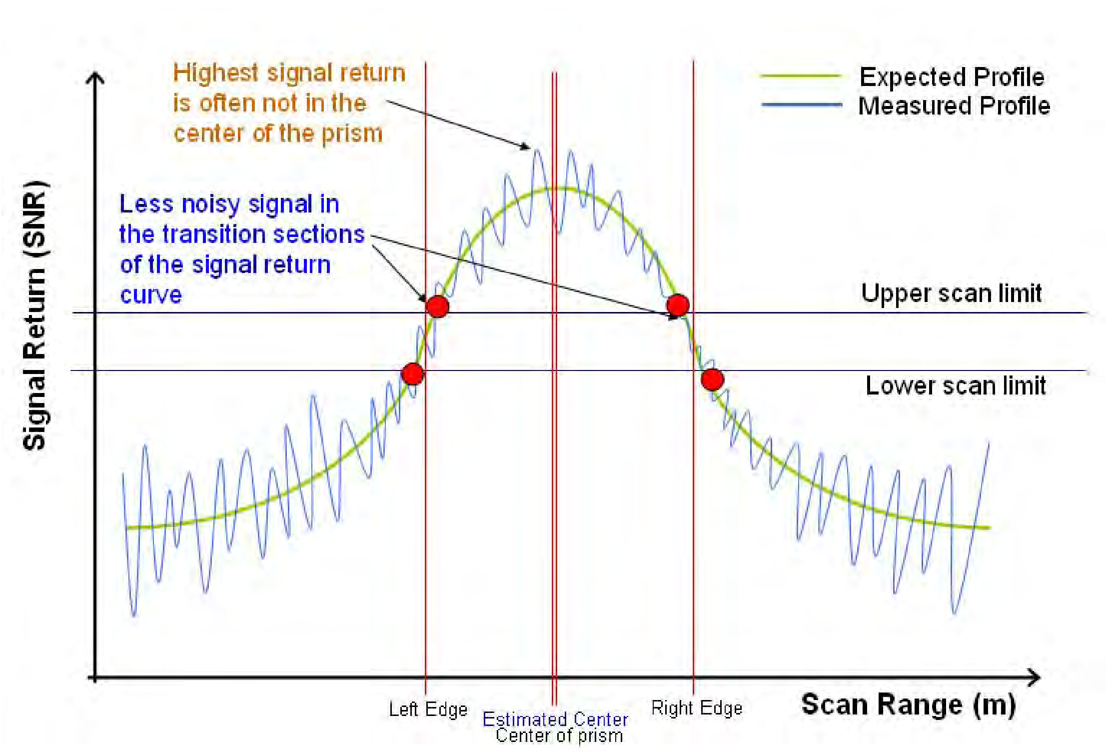
	▪ The signal scan procedure requires a very good, fast, full-duplex communication line. ▪ Accuracy is approx. +/- 0.3m.	applied for long distance measurements.

Warning:

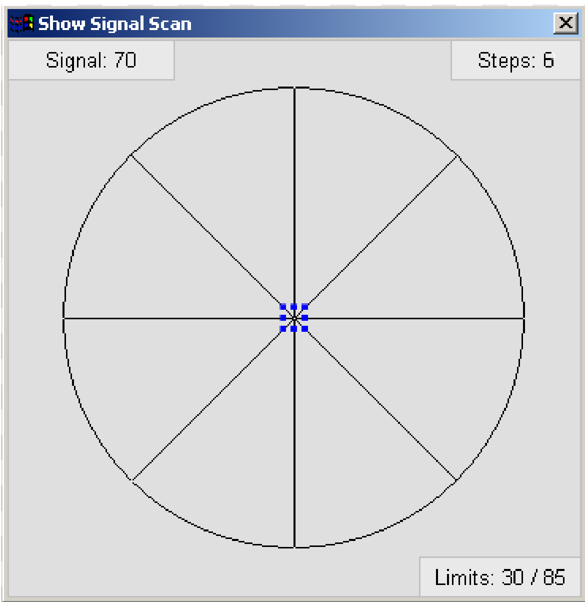
- The measurement mode Signal Scan should only be used if it is not possible to measure with ATR.
- It is **not** possible to use the measurement mode Signal Scan and Distance Only **together**, because the coordinate calculation and distance reduction parameters are globally applied for a total station.
- See TPS Properties: Calculations for information on how to configure the coordinate calculation to **full measurement** and the distance reduction to **using vertical angles**.

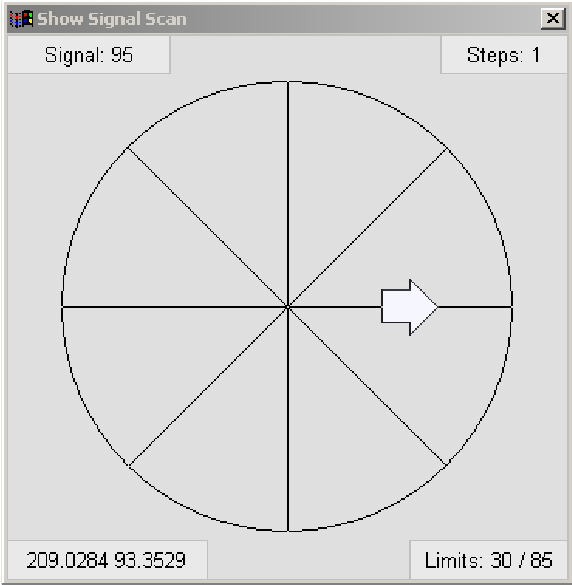
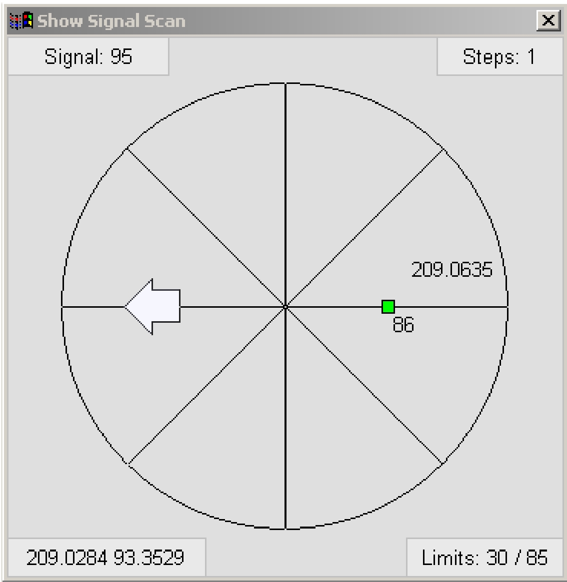
Principle of Signal Scanning

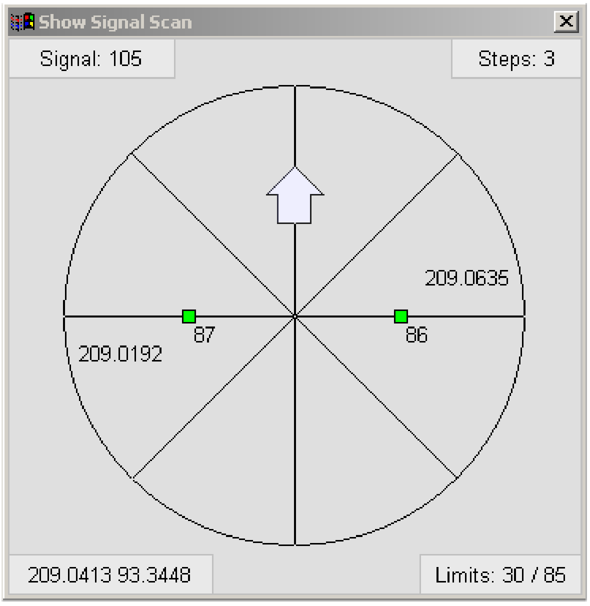
A scan is made to find the edges of the signal above, below, left and right of the prism which are then used to calculate the position of the centre of the prism for the angle measurements. Due to the typical pattern of the signal return, shown in the diagram below, a pair of limits (upper and lower) and some special calculations are used to reliably determine the edge of the signal. Since many measurements must be taken to find the edges, signal scan is quite slow. A single scan may take between 30 seconds and two minutes or even longer under certain conditions.

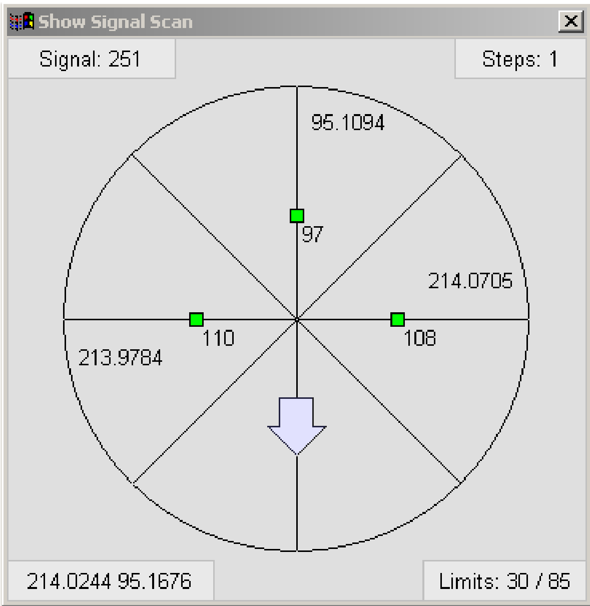


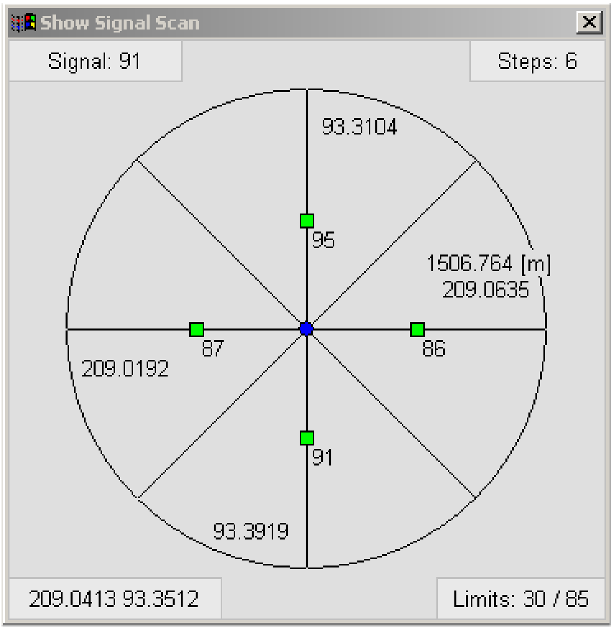
The flow of the signal scan is

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>Search for good signal. If no signal found then a "Point not found" message is generated.

</td></tr>
</table>

2	Find right edge. 
3	Find left edge. 
4	Find top edge.

<table>
<tr><td></td><td>
</td></tr>
<tr><td>5</td><td>Find bottom edge.


</td></tr>
<tr><td>6</td><td>Final measurement of distance and angles.</td></tr>
</table>



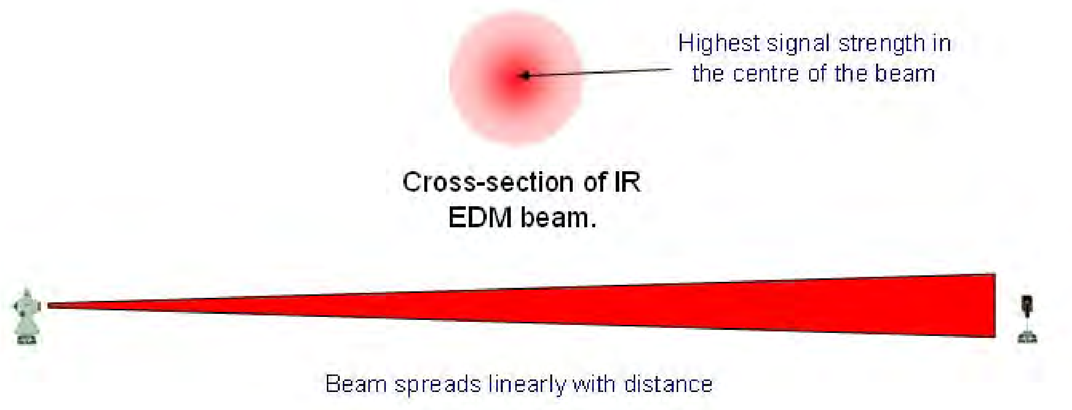
Notes:

- If at any stage the edge detection criteria are not satisfied then a "Point not found" message is generated.
- The progress of the signal scan can be seen in the Signal Scan View.
- Ensure that the total station is in the GeoCOM Online mode.

SignalScan (IR)

The signal scan using the IR EDM has the following characteristics:

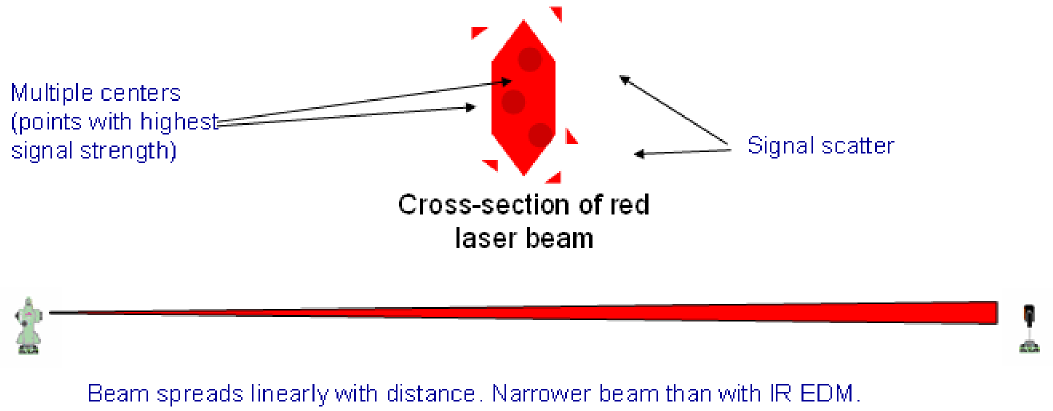
- IR EDM produces a circular beam with point of highest signal return in the center of the beam.
- The circular IR beam spreads as a function of distance. At 1000m the beam is approximately 20-30cm (3 prisms) wide.
- Accuracy of the angle measurement decreases with distance due to the spread of the beam.
- The IR beam works well through glass because there is minimal signal reflection.



SignalScan (LO)

The signal scan using the red laser EDM has the following characteristics:

- The red laser EDM used for reflectorless distance measurement is much narrower (1/10th of IR) over long distances.
- Due to the beam with a higher accuracy is possible using Signal Scan (LO) than Signal Scan (IR).
- If shooting through glass (especially at oblique angles), signal reflection can be a problem and result in outliers.
- More complicated due to irregular (non-circular) shape, multiple centers and possible signal scattering.



Related Topics

Measurement Modes

Signal Scan View

Distance Only Coordinate Calculation

When to use

Use the measurement mode Distance Only

- to measure the slope distances of a prism that is beyond the range of the Automatic Target Recognition (ATR).

Background Information

The measurement mode Distance Only requires a special coordinate calculation. The distance only calculation is a special calculation that enables calculation of three dimensional displacements using only measured distances. This calculation makes it possible to monitor over very long distances where ATR does not work and Signal Scan gives very poor accuracy.

Two distance only measurement modes are available:

- Distance Only (IR)
- Distance Only (LO)

These modes are based on the two types of EDM that are used in Leica total stations (infrared IR and redlaser LO).

Distance Only Requirements

GeoMoS Monitor - Configuration - Sensor Location Editor - TPS Properties: Calculations configured for 1D Monitoring:

- Coordinate calculation set to **Only measured distance**
- Distance Reduction set to **Using End Heights**

Orientation correction is determined with the point group "Free Station" or "Orientation Only" Control point coordinates are determined with the point group "Free Station" or "Distance Intersection", if required.

Signal Scan vs. Distance Only Measurement Mode

The signal scan measurement mode only makes sense if the distance to a point is **outside of the ATR** range. Signal scanning is inherently slower and less accurate than ATR measurement.

The distance only measurement mode only makes sense if the distance to a point is **outside of the ATR** range and the customer is only interested in Longitudinal displacements, slope distance measurements and ppm values.

	Signal Scan (SignalScan IR/LO)	**Distance Only (DistanceOnly IR/LO)**
Advantage ✓	▪ Determines the three dimensional position of a prism. ▪ Angles are recorded as well but will be very inaccurate.	▪ The slope distance is measured high-precise. ▪ Detects movements only in the direction of the distance measurement. ▪ Measures only the slope distances using the EDM. A single measurement is very fast. ▪ Accuracy is based on EDM. ▪ Longitu dinal displacement, Slope distance and PPM can be used for analysis.
Disadvantage ✗	▪ Depends on the atmospheric conditions ▪ Over very long distances (several kilometers) signal scan is not practical because the angle measurements become very inaccurate.	▪ No angles are measured. ▪ Requires a special monitoring setup geometry to be able to detect movements. ▪ The profile direction should be similar to the measurement direction of the instrument,

	▪ A single signal scan to one prism may take between 30 seconds and two minutes or even longer under certain atmospheric conditions. ▪ The signal scan procedure requires a very good, fast, full-duplex communication line. ▪ Accuracy is approx. +/- 0.3m.	because of the special calculation method. ▪ Transverse and Height displacement cannot be used for analysis. ▪ Operation of system and analysis of data is more complicated in a 1D than in a normal 3D system. ▪ Depends on the atmospheric conditions. The atmospheric corrections should be applied for long distance measurements.

Warning:

- The measurement mode Distance Only should only be used if it is not possible to measure with ATR or Signal Scan.
- See TPS Properties: Calculations for information on how to configure the coordinate calculation to **only measured distances** and the distance reduction to **using end heights**.
- The profile direction should be similar to the line of sight of the instrument. See the Profile Editor for further information.
- For the system to follow a point, the **search window** in the point group editor must be greater than 0.

Principles of Distance Only Calculation

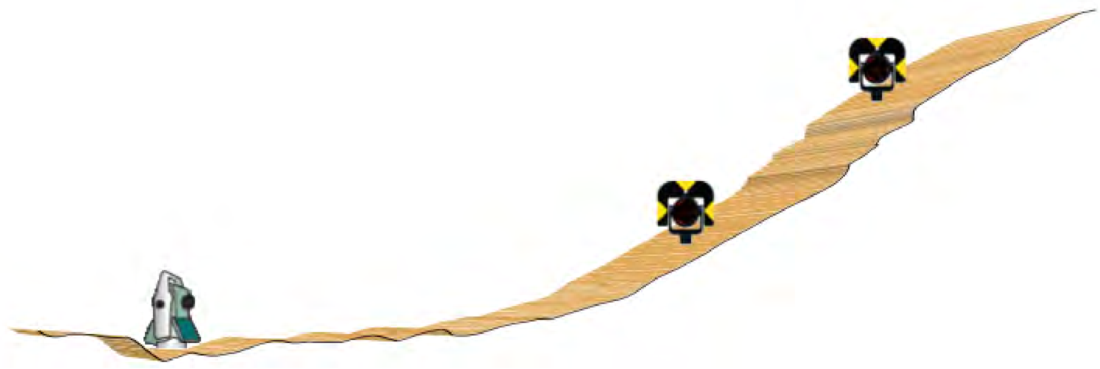
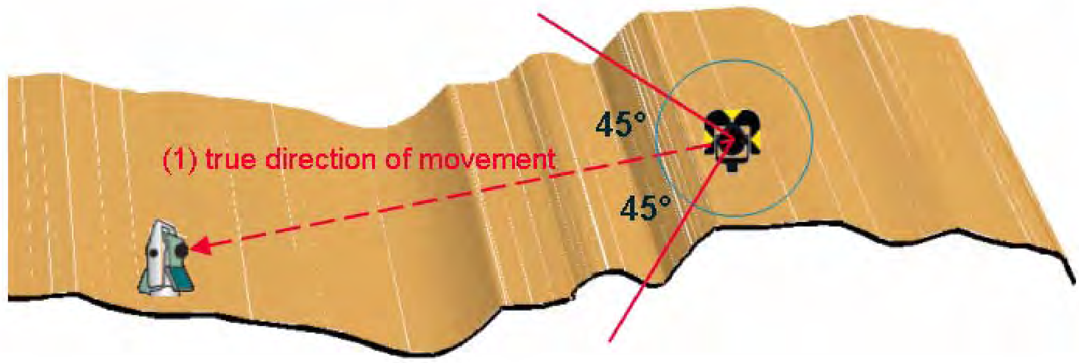
The distance only based coordinate calculation has the following characteristics:

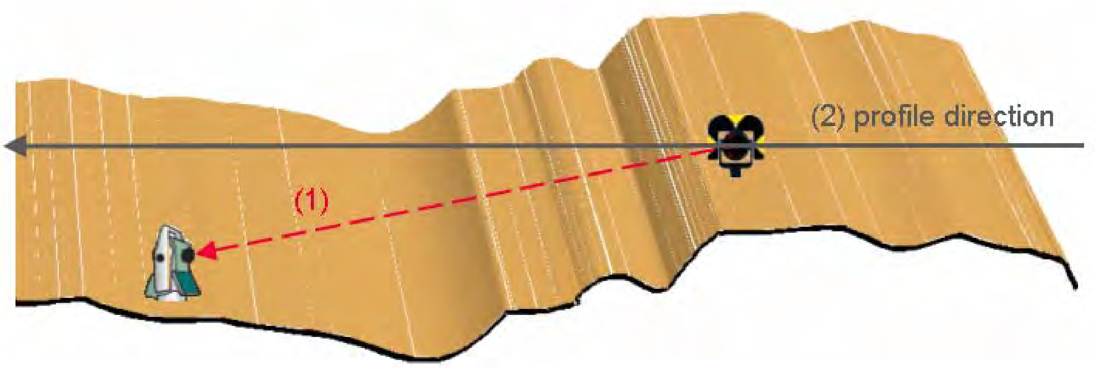
- Over very long distances (several kilometers) signal scan is not practical because the angle measurements become very inaccurate, but distance measurement is still possible.
- Movements can be monitored effectively using only distance measurements.
- The distance measurement from total stations is highly accurate even over very long distances.
- The method is only limited by range of EDM.
- Operation of system and analysis of data is more complicated than in a normal system.

Method of Distance Only Coordinate Calculation

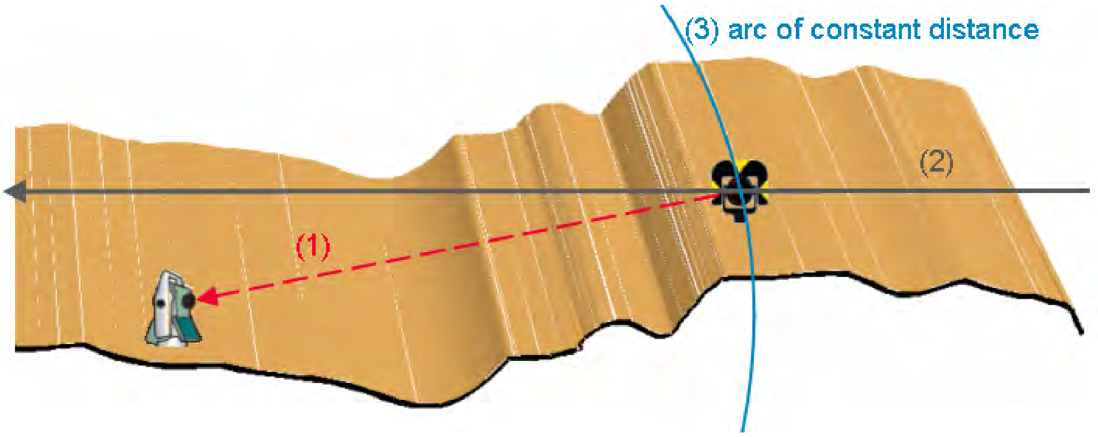
- The intersection of the profile direction and the distance measurement is used to calculate the position of the target (see the diagram below).
- This calculation mode is the only case where the scan coordinates and current coordinates are not equal.
- In time, the reference coordinates will differ substantially from the current coordinates.
- The difference between the actual and measured displacements will increase with time (the accuracy of the calculation will reduce with time).
- It is necessary to periodically conduct a control survey to update the reference coordinates.

Step	Example "landslide monitoring system"
1	**TPS Properties** Define in the Sensor Location Editor - TPS Properties dialog an 1D monitoring system with the following settings: ▪ **Only measured distances** and **Using End heights** These two total station settings refer to the so-called "distance only computation".
	Setup ▪ The "**1**" true direction of movement and expected direction of movement should be similar to the measurement direction of the instrument (+/-45°), because of the special calculation method. Side view

	 Top view 
3	**Point coordinates** ▪ Import the point coordinates into the **Point Editor** with a .GSI or .Koo file. ▪ For each point the coordinate types (null, reference, current, scan) are identical. Check with Tools - Point Viewer.
	Profile direction ▪ Use the Profile Editor to define the profile direction. ▪ The "**2**" profile direction should be similar to the true direction of movement and measurement direction of the instrument (+/-45°), because of the special calculation method. ▪ The profile for each point is defined with the reference coordinate and the profile direction.

<table>
<tr><td></td><td>
</td></tr>
<tr><td></td><td>1st measurement

The total station aims to the point IDs "scan" coordinate and measures the prism only with a slope distance.
No Hz and V angles are recorded.
The intersection of a line ("2" profile direction) and a circle ("3" arc of constant slope distance) is now used to calculate the position of the points coordinate and the longitudinal displacement.
The calculated position is represented with the current coordinate.


</td></tr>
<tr><td>6</td><td>Following measurements

After time, the monitoring point starts to slide. This is the direction of the real movement.
The position of the coordinate is computed with the intersection of the "2" profile direction and the "3" arc of slope distance.
</td></tr>
</table>

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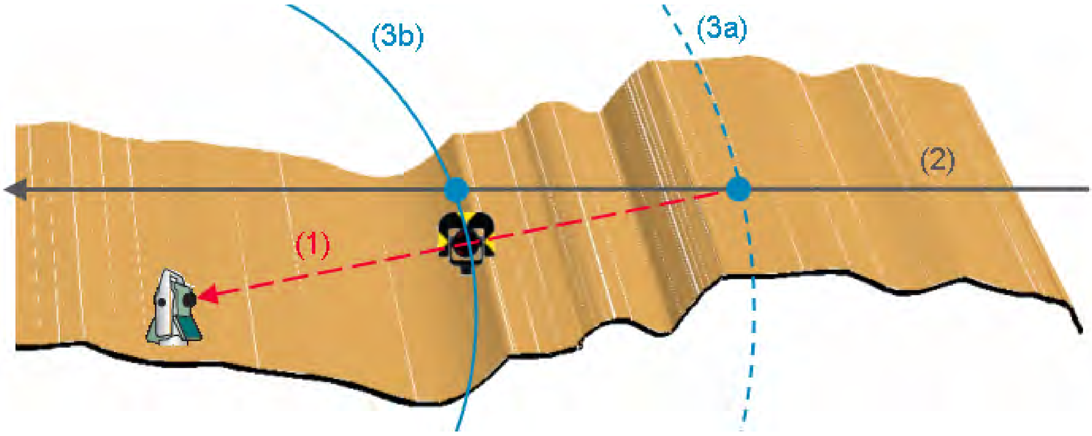
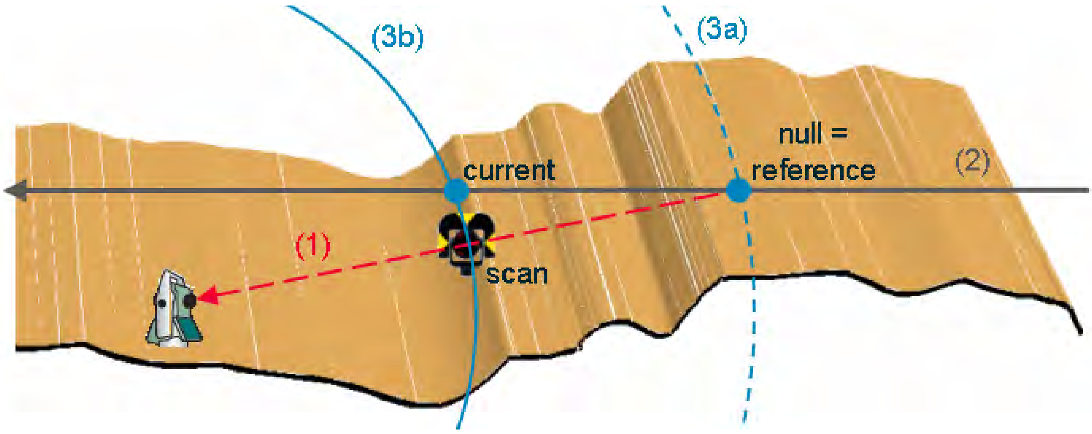
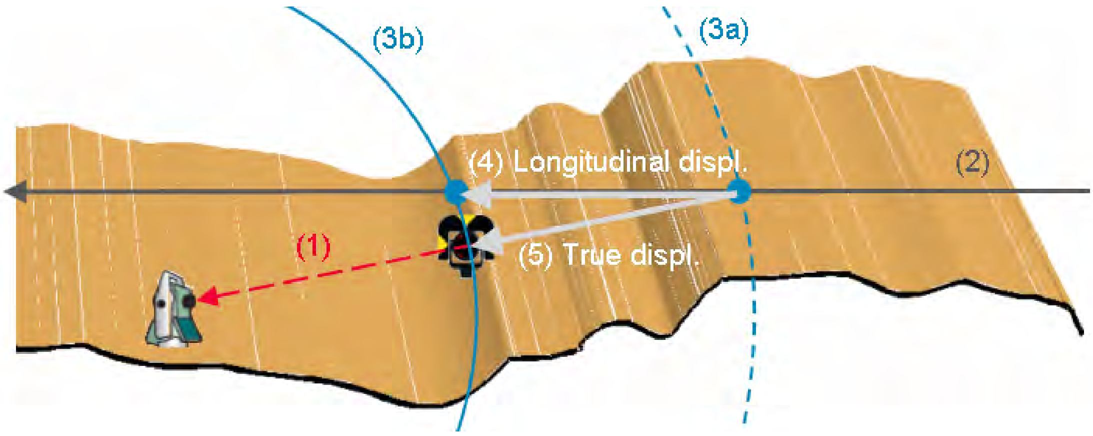
<td>


The "null", "scan" and "current" coordinates start to differ. The "null" and the "reference" coordinates are identical.
The "scan" coordinate is the target coordinate used when positioning the telescope and search for the target. The "current" coordinate is the calculated position.

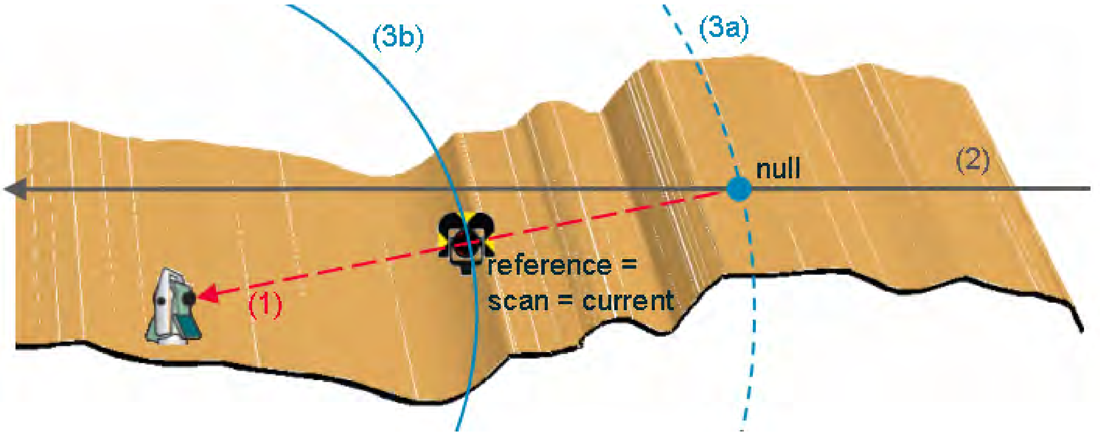
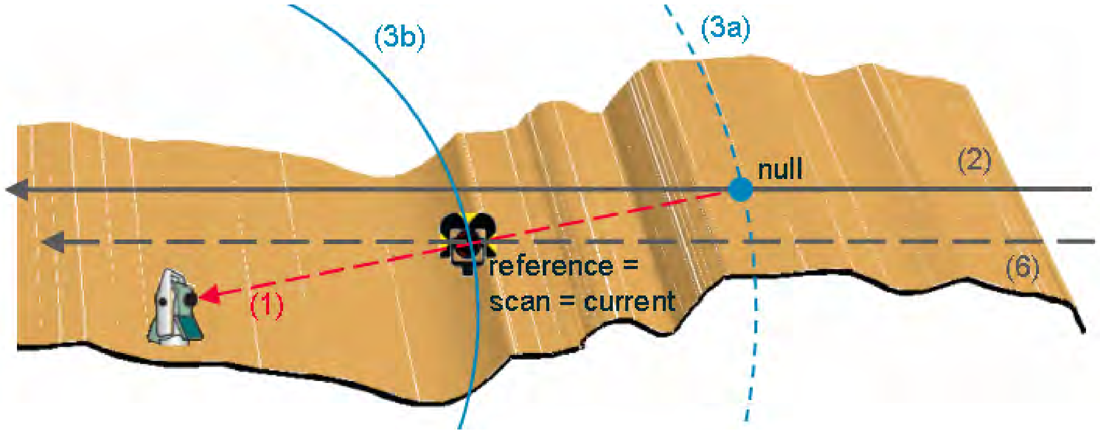


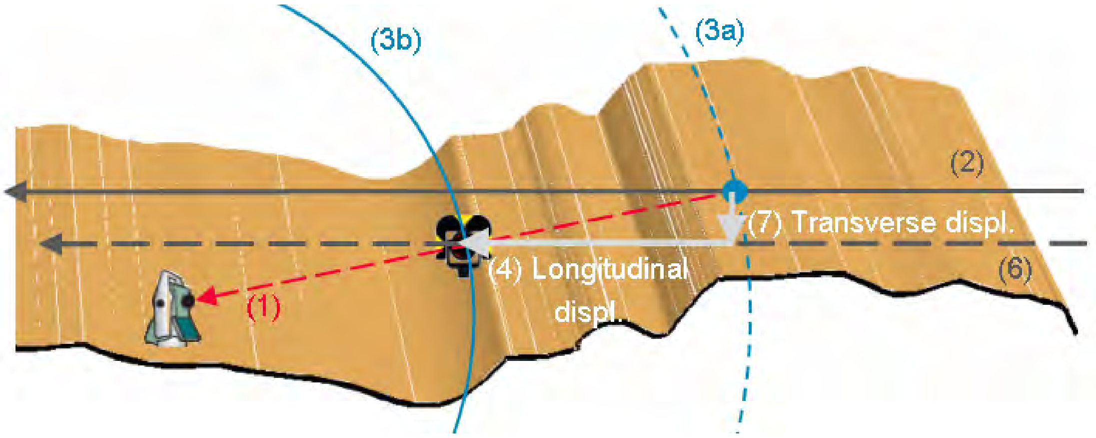
</td>
</tr>
<tr>
<td>7</td>
<td>
Longitudinal displacement

The "4" longitudinal displacement vector is based on the profile direction.
The longitudinal displacement vector is <u>not</u> the "5" true displacement vector between the original prism position ("null" coordinate) and the real prism position ("scan" coordinate).



</td>
</tr>
</table>

8	**Control survey** ▪ The difference between the calculated and measured displacements will increase with time (the accuracy of the calculation will reduce with time). ▪ It is necessary to periodically conduct a control survey to update the reference coordinates. For example the prisms can be measured with GNSS.
9	**Update point coordinates** ▪ Import the new point coordinates into the **Point Editor** with a .GSI or .Koo file. ▪ For each point the coordinate types (reference, current, scan) will be updated and are identical. The "null" coordinate is not updated. Check with Tools - Point Viewer. 
10	**Profile direction** ▪ The profile for each point is defined with the reference coordinate and the profile direction. ▪ The direction of the profile is identical. ▪ The position of the profile "**6**" is shifted parallel to the original position of the profile direction. 
11	**Longitudinal and transverse displacement**

	▪ The "**4**" longitudinal displacement vector is based on the profile direction. ▪ The longitudinal displacement vector is <u>not</u> the "**7**" true displacement vector between the original prism position ("null" coordinate) and the real prism position ("scan" coordinate). 
12	**Repeat** Repeat the Step 8 and Step 9 for the monitoring points if the difference between the calculated and measured displacements will increase with time.

Examples of Coordinate Systems

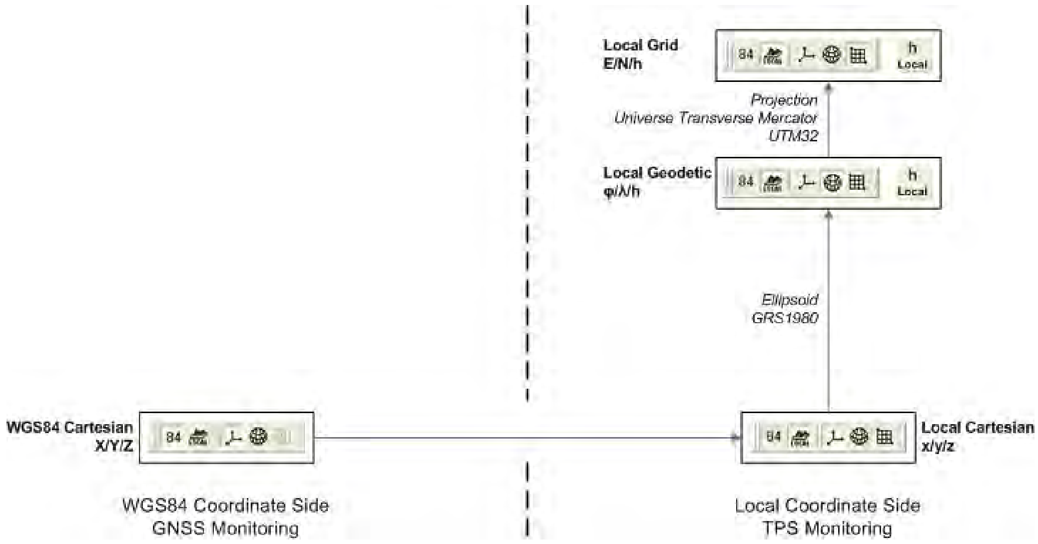
Coordinate Systems can be divided in two different types:

- Global Coordinate Systems: Calculations without Transformations
- Local Coordinate Systems: Calculations with Transformations

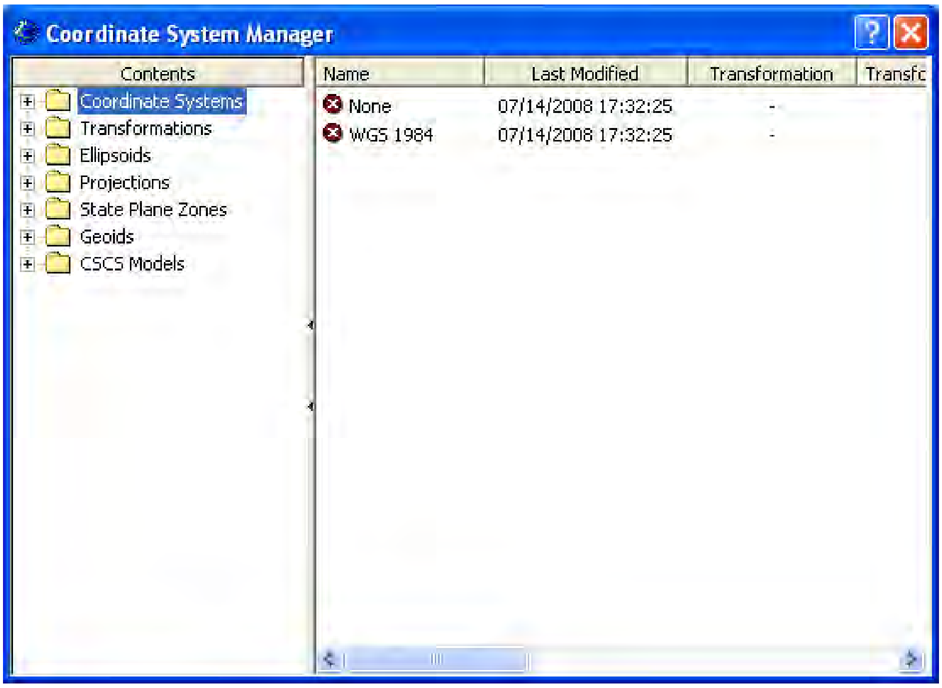
Available examples of Coordinate Systems:

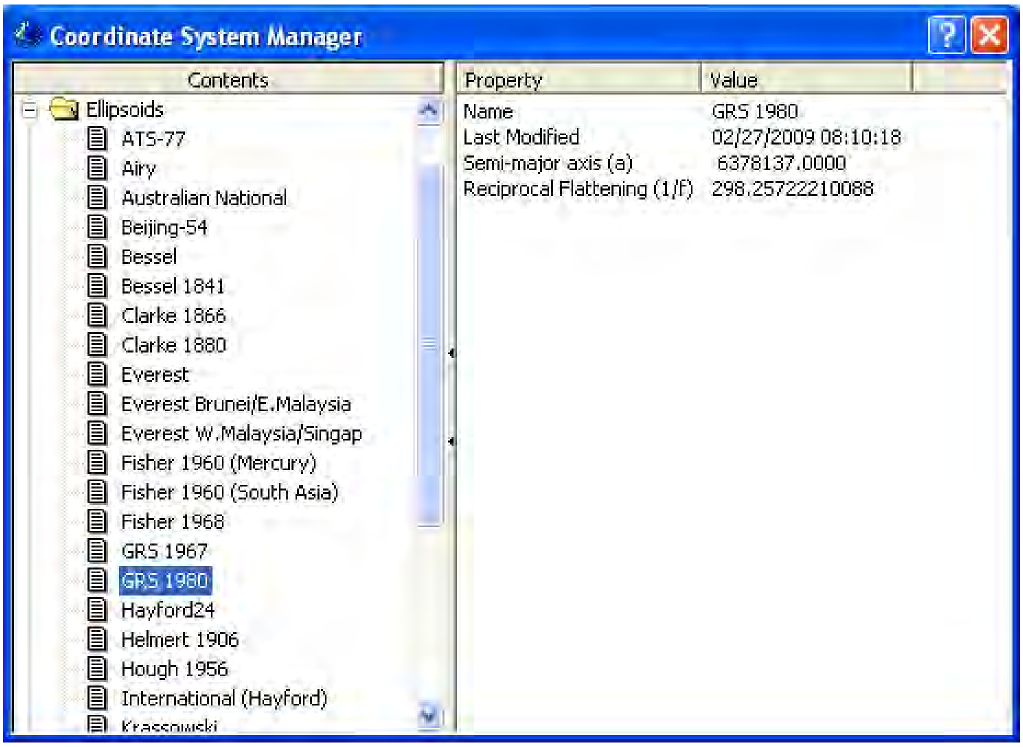
Example	Description	Type
1	International Coordinate System, for example Europe	Global
2	National Coordinate System, for example Baden-Württemberg, Germany	Local
3	National Coordinate System, for example Switzerland	Local
4	Local Coordinate System for a construction site	Local

Example 1: International Coordinate System (Europe)



Follow these steps to configure a global Coordinate System, e.g. Europe.

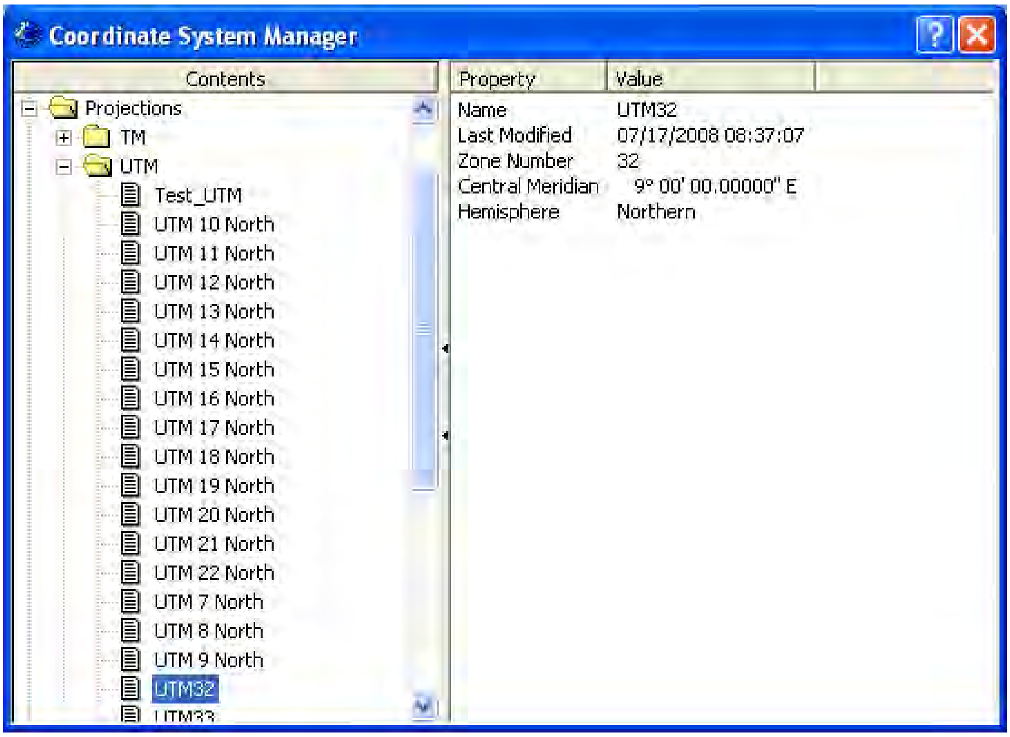
Step	Action
1	In **GeoMoS Monitor**, go to **Configuration** > **Options**. The **Options** dialog opens, select the  button.
2	The Coordinate System Manager dialog box opens.  The tree view on the left allows navigation of the Coordinate System Manager.
3	**Transformation** There is no transformation needed.
4	**Ellipsoid** A global ellipsoid is for example WGS84 or GRS80. Check if the appropriate global Ellipsoid is available or add a new global Ellipsoid.



5

Projection

Check if the appropriate Universal Transverse Mercator Projection (UTM), e.g. UTM32 is available or add a new UTM Projection.

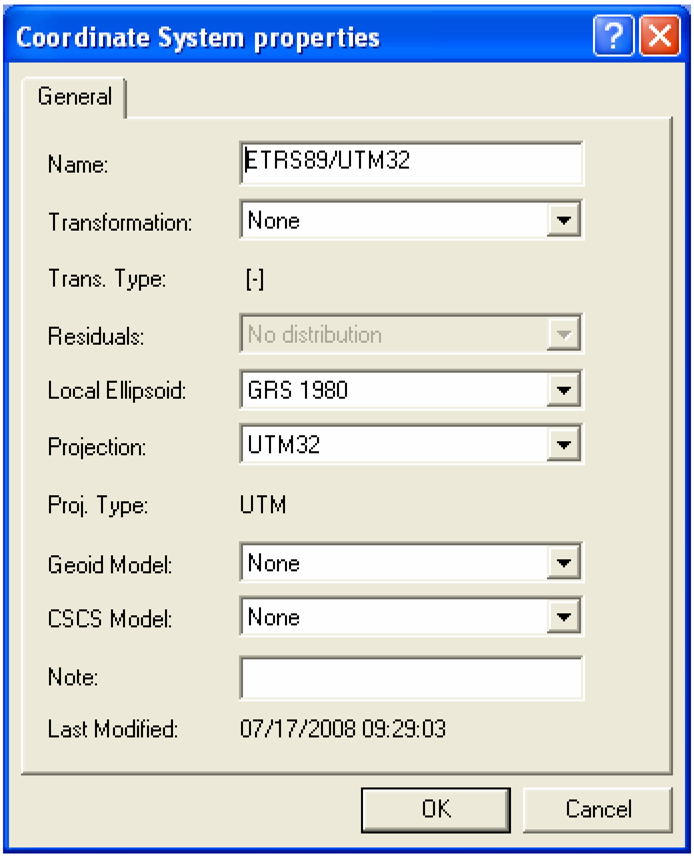


<table>
<tr><td></td><td></td></tr>
<tr><td>6</td><td>

Coordinate System properties:

Define a new coordinate System with the following settings:

- Name: e.g. ETRS89/UTM32
- No Transformation
- Ellipsoid: GRS1980
- Projection: UTM32
- No Geoid Model
- No CSCS Model

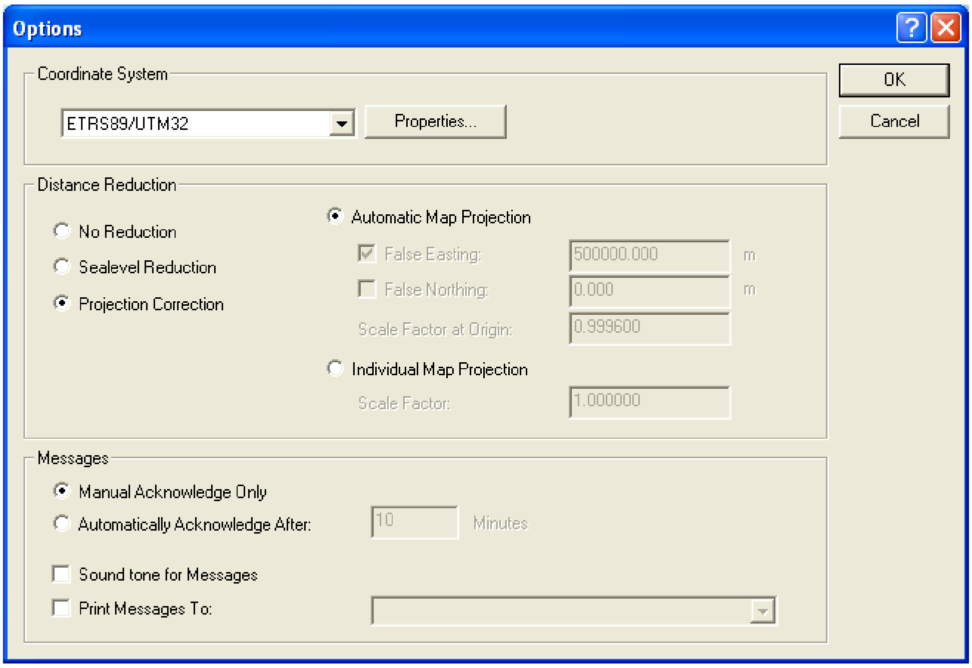


</td></tr>
<tr><td>7</td><td>Close the Coordinate System Manager.</td></tr>
<tr><td>8</td><td>

In the **GeoMoS Monitor Options** dialog:

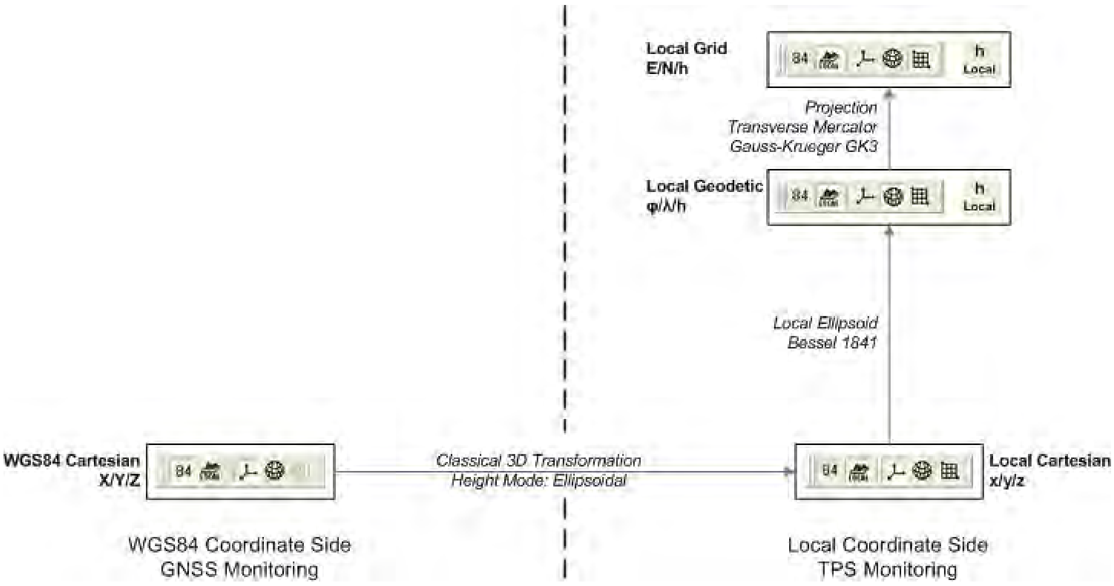
- Select your predefined Coordinate System: e.g. ETRS89/UTM32
- Select **Projection correction (Distance Reduction)**
- The Projection correction scale factor is used automatically.

</td></tr>
</table>

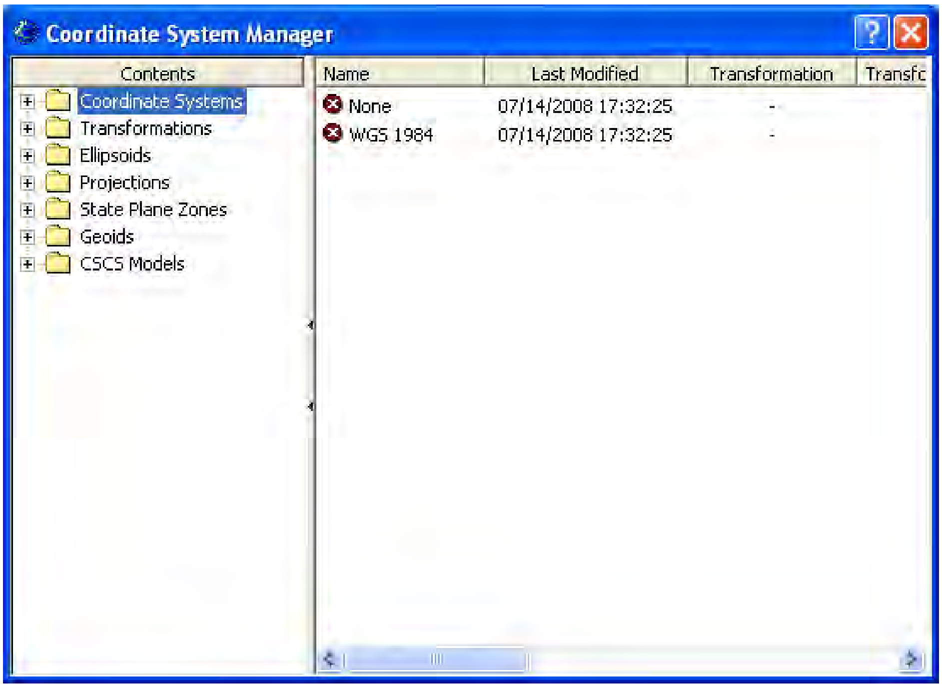


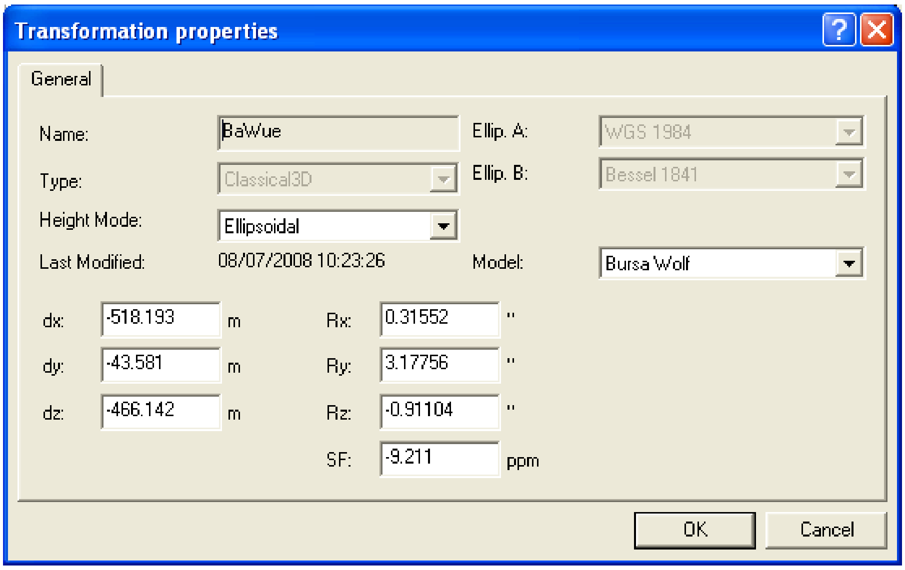
9	Press OK to confirm or Cancel to abort the function.

Example 2: National Coordinate System (Baden-Württemberg, Germany)



Follow these steps to configure a national Coordinate System, for Baden-Württemberg, Germany.

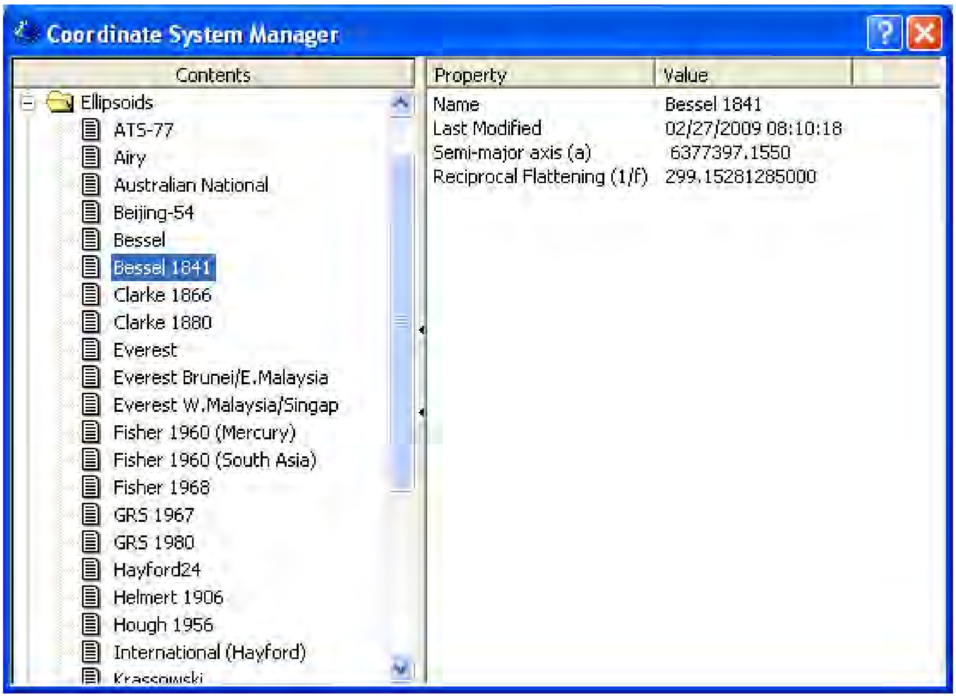
Step	Action
1	In **GeoMoS Monitor**, go to **Configuration** > **Options**. The **Options** dialog opens, select the  button.
2	The Coordinate System Manager dialog box opens.  The tree view on the left allows navigation of the Coordinate System Manager.
3	[Transformation]() A Transformation is a description with (calculation) parameters on how to transfer from a global to local Cartesian Coordinate System. Check if the appropriate Transformation (Classical 3D) is available or add a new Transformation (Classical 3D).

<table>
<tr><td></td><td>
</td></tr>
<tr><td>4</td><td>

Ellipsoid

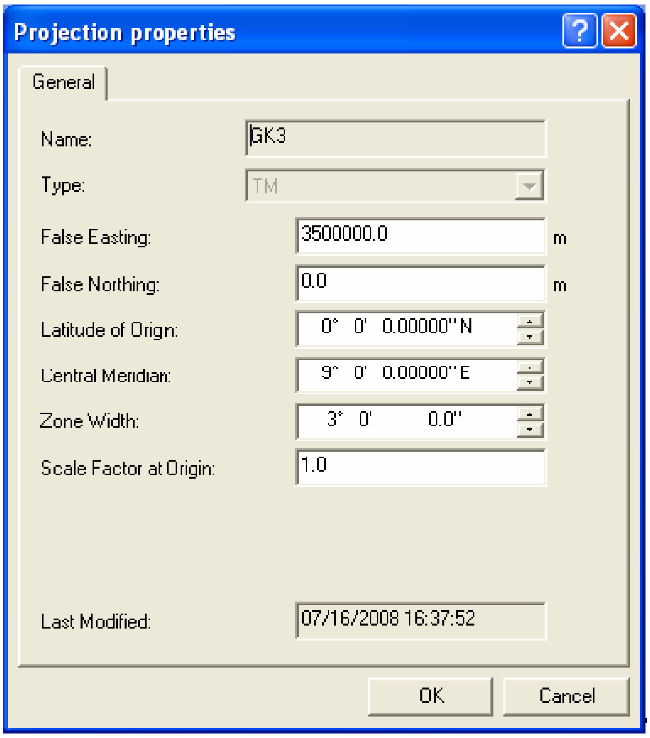
A national ellipsoid is for example Bessel1841.

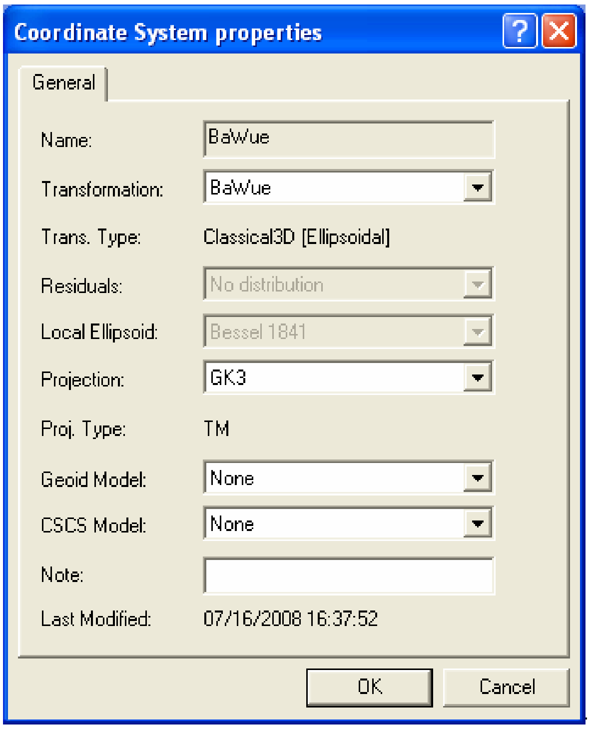
Check if the appropriate local Ellipsoid is available or add a new local Ellipsoid.


</td></tr>
<tr><td>5</td><td>

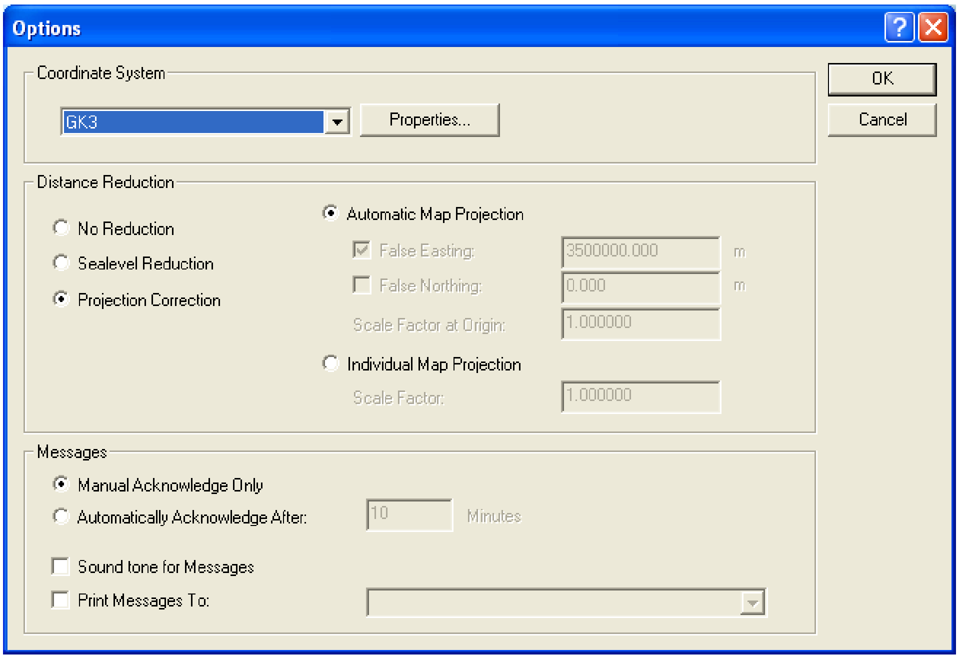
Projection

Check if the appropriate Projection, e.g. Gauss-Krueger GK3 (Transverse Marcator, TM) is available or add a new Projection.</td></tr>
</table>

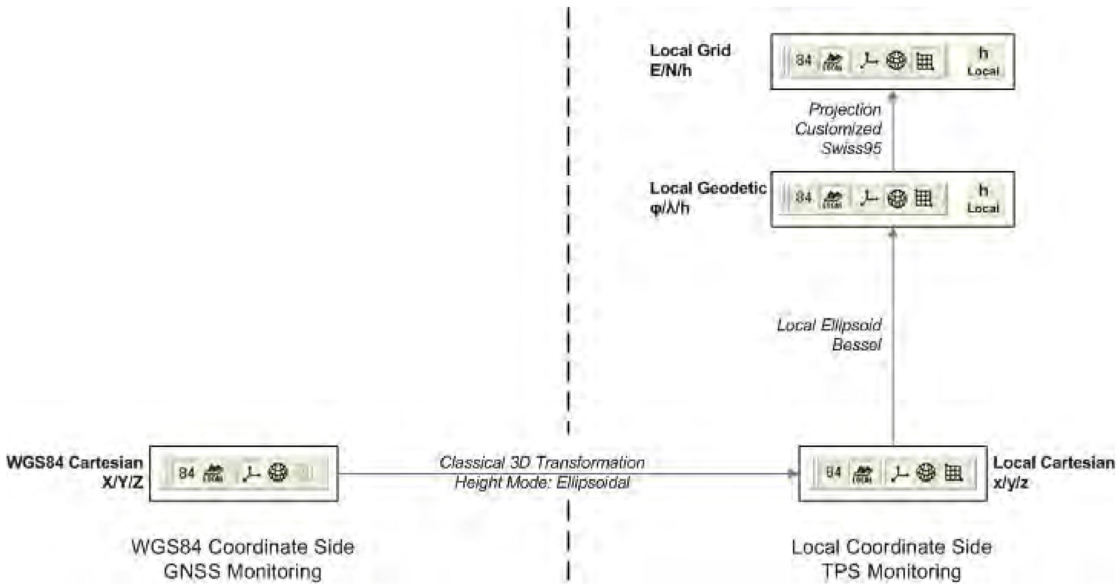
	
6	**Coordinate System properties**: Define a new coordinate System with the following settings: ▪ Name: e.g. BaWue ▪ Classical 3D Transformation: BaWue ▪ Local Ellipsoid: Bessel 1841 ▪ Projection: GK3 ▪ No Geoid Model ▪ No CSCS Model

<table>
<tr><td></td><td>
</td></tr>
<tr><td>7</td><td>Close the Coordinate System Manager.</td></tr>
<tr><td>8</td><td>In the GeoMoS Monitor Options dialog:

Select your predefined Coordinate System: e.g. GK3
Selec t Projection correction (Distance Reduction)
The Projection correction scale factor is used automatically.

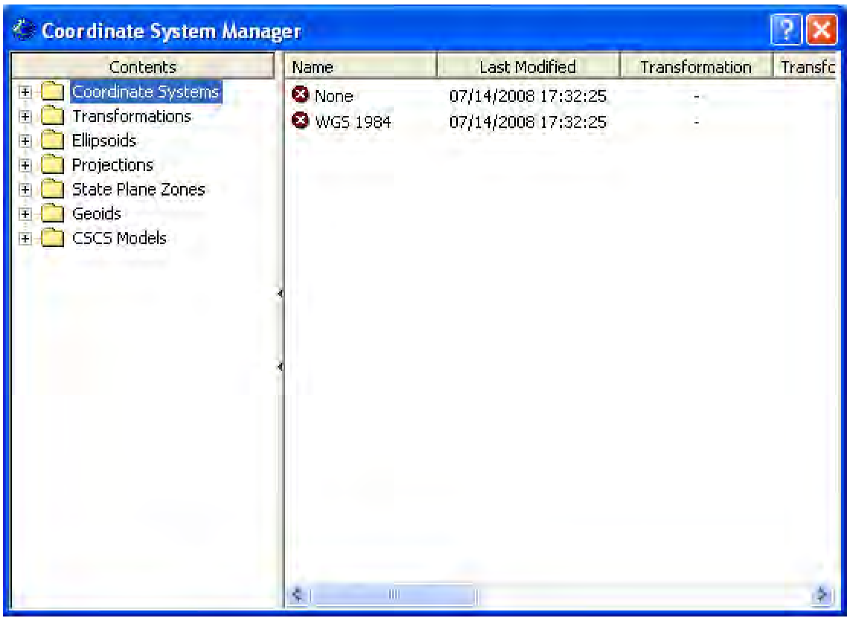
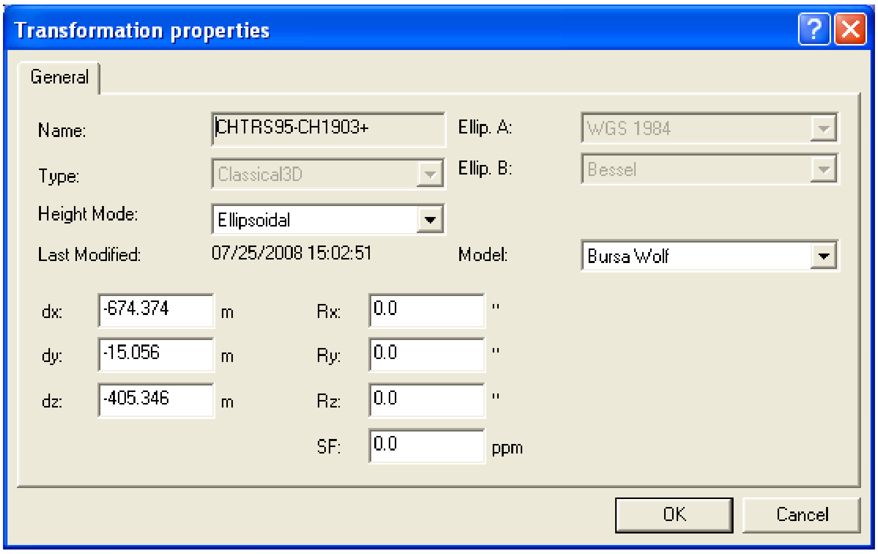

</td></tr>
<tr><td>9</td><td>Press OK to confirm or Cancel to abort the function.</td></tr>
</table>

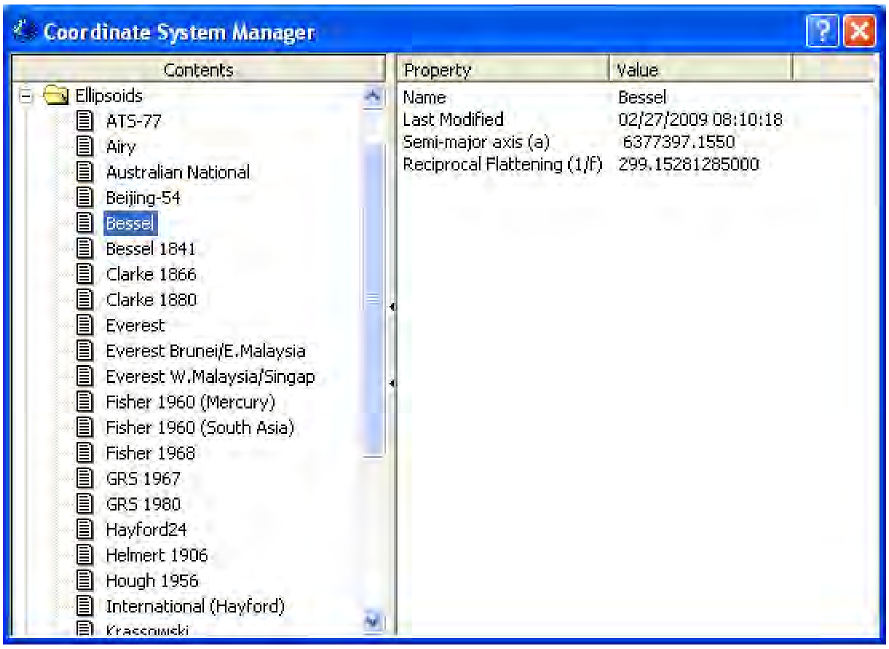
Example 3: National Coordinate System (Switzerland)



Follow these steps to configure a national Coordinate System, for Switzerland.

Step	Action
1	In **GeoMoS Monitor**, go to **Configuration** > **Options**. The **Options** dialog opens, select the Properties... button.
2	The Coordinate System Manager dialog box opens.

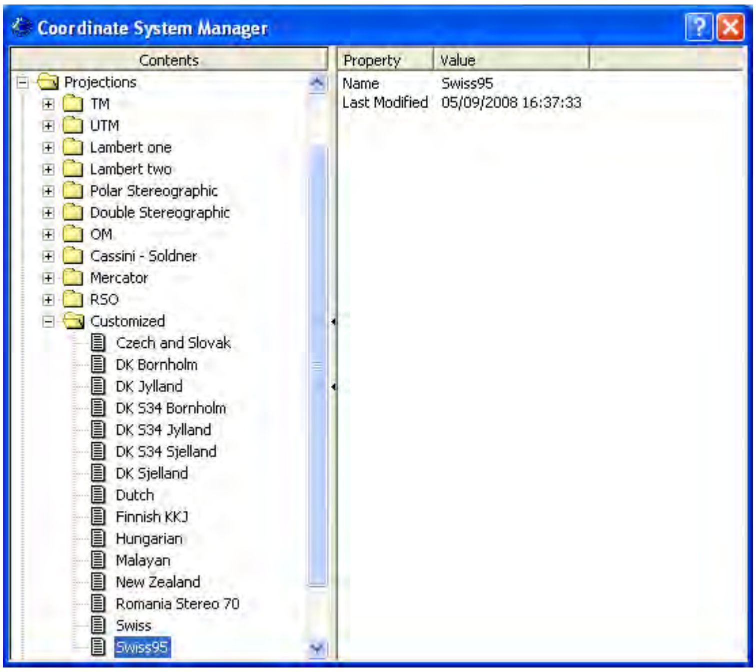
	 The tree view on the left allows navigation of the Coordinate System Manager.
3	**Transformation** A Transformation is a description with (calculation) parameters on how to transfer from a global to local Cartesian Coordinate System. Check if the appropriate Transformation (Classical 3D) is available or add a new Transformation (Classical 3D). 
4	**Ellipsoid** A national ellipsoid is for example Bessel. Check if the appropriate local Ellipsoid is available or add a new local Ellipsoid.

<table>
<tr><td></td><td>


</td></tr>
<tr><td>5</td><td>

Projection

Check if the appropriate Projection, e.g. Swiss95 (Customized) is available or add a new Projection.

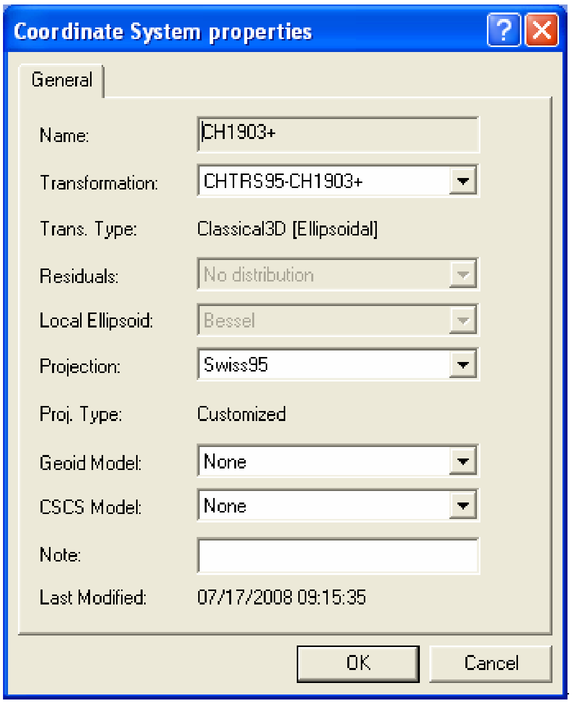


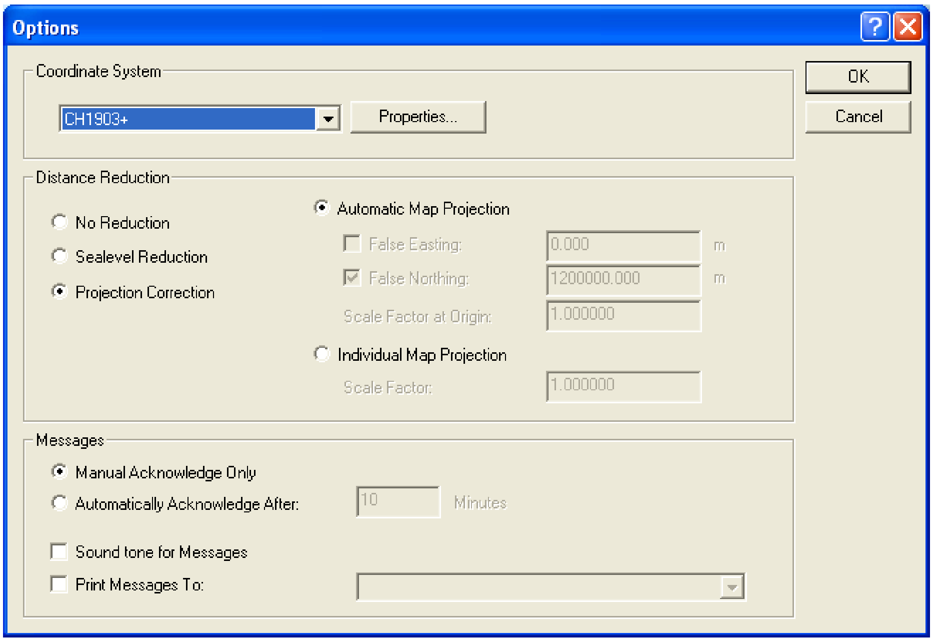
</td></tr>
<tr><td>6</td><td>

Coordinate System properties:

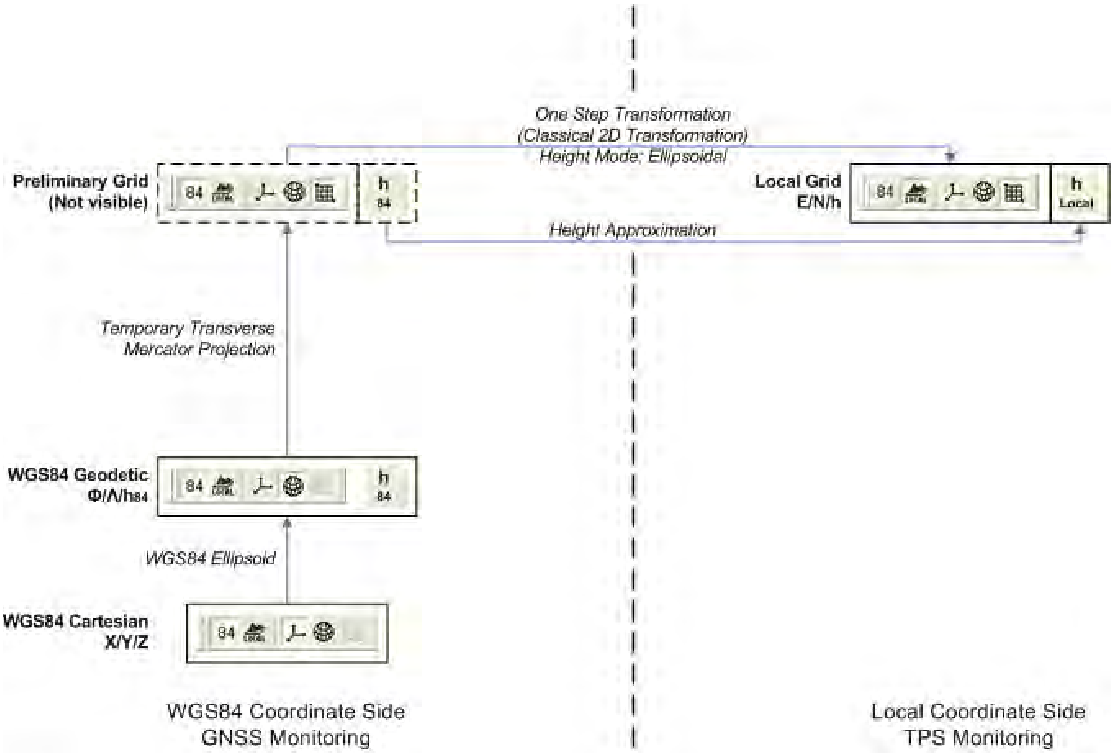
Define a new coordinate System with the following settings:

- Name: e.g. CH1903+
</td></tr>
</table>

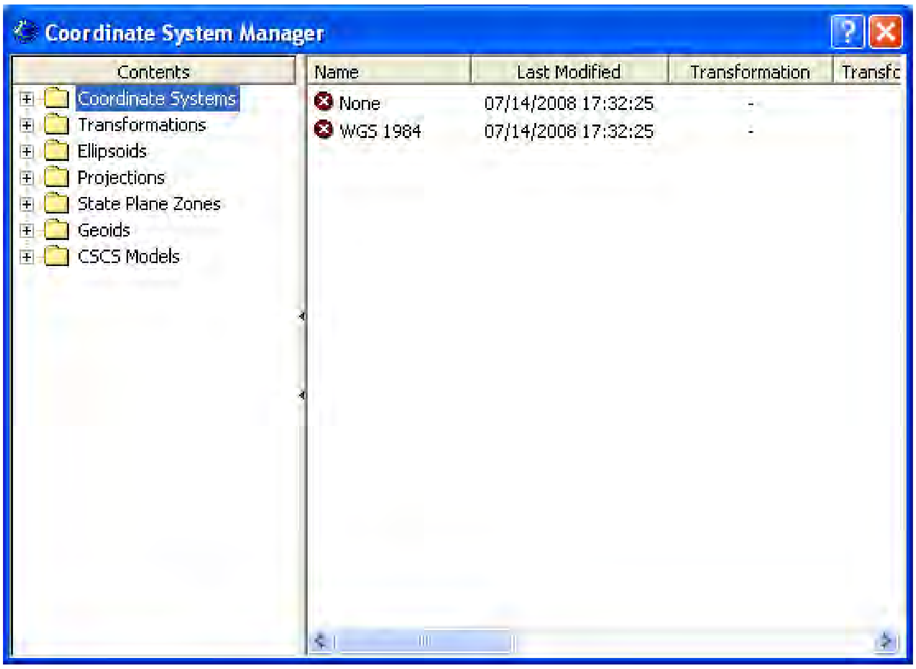
	▪ Classical 3D Transformation: CHTRS95-CH1903+ ▪ Local Ellipsoid: Bessel ▪ Projection (Customized): Swiss95 ▪ No Geoid Model ▪ No CSCS Model 
7	Close the Coordinate System Manager.
8	In the **GeoMoS Monitor Options** dialog: ▪ Select your predefined Coordinate System: e.g. CH1903+ ▪ Selec t **Projection correction (Distance Reduction)** ▪ The Projection correction scale factor is used automatically.

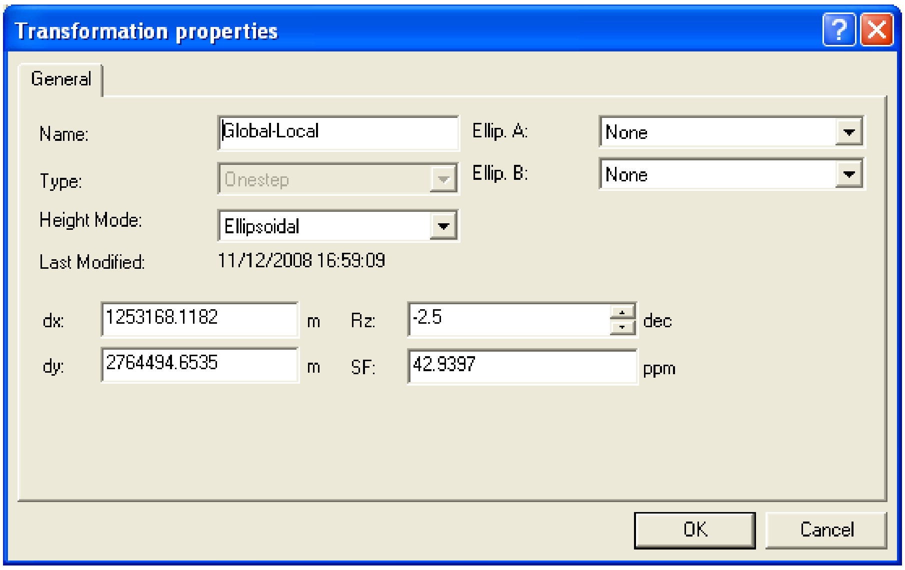
	
9	Press OK to confirm or Cancel to abort the function.

Example 4: Local Coordinate System for a construction site

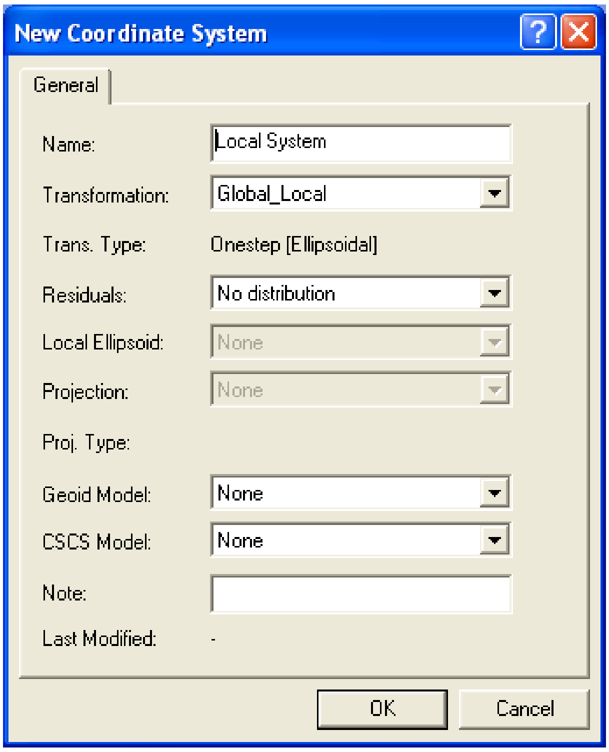


Follow these steps to configure a local Coordinate System, for a construction site.

Step	Action
1	In **GeoMoS Monitor**, go to **Configuration** > **Options**. The **Options** dialog opens, select the  button.
2	The Coordinate System Manager dialog box opens.  The tree view on the left allows navigation of the Coordinate System Manager.
3	[Transformation] A Transformation is a description with (calculation) parameters on how to transfer from a global to local Cartesian Coordinate System. Note: For this use case you need the **Leica LGO Datum/Map** tool to compute the parameters for a One Step Transformation. Check if the appropriate Transformation (One Step) is available or compute a new Transformation (One Step) with the Leica LGO Datum/Map tool and import it to the Coordinate System Manager.

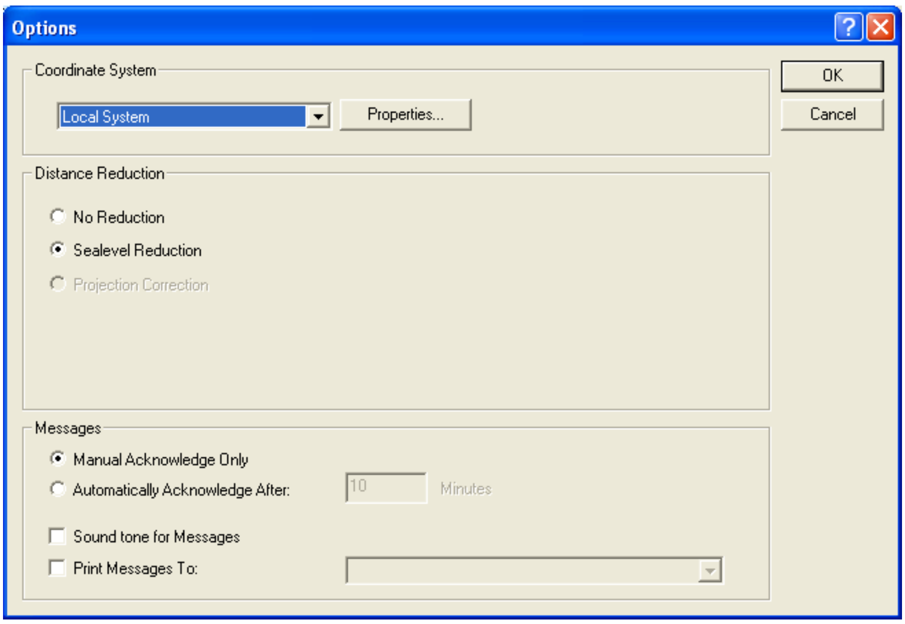


4	**Ellipsoid** There is no Ellipsoid needed.
5	**Projection** There is no Projection needed.
6	**Coordinate System properties**: Define a new coordinate System with the following settings: ▪ Name: e.g. Local System ▪ One Step Transformation: Global_Local ▪ No Ellipsoid ▪ No Projection ▪ No Geoid Model ▪ No CSCS Model

<table>
<tr><td></td><td>


</td></tr>
<tr><td>7</td><td>Close the Coordinate System Manager.</td></tr>
<tr><td>8</td><td>In the GeoMoS Monitor Options dialog:

- Select your predefined Coordinate System: e.g. Local System
- Selec t **Projection correction (Distance Reduction)**



</td></tr>
<tr><td>9</td><td>Press OK to confirm or Cancel to abort the function.</td></tr>
</table>

Related topics

[Options dialog]

[Tour VIII: Configure a Coordinate System]

NMEA Format

The NMEA GGA format is a standard format for transmitting coordinates derived from GPS receivers and is supported by most GPS receivers.

The NMEA GNS format is a standard format for transmitting coordinates derived from combined satellite navigation systems (GPS, GLONASS, possible future satellite systems, and combining these).

Format	Format	Content
$GPGGA,	$GPGNS,	Header, incl. Talker ID, message sent from the Receiver
hhmmss.ss,	hhmmss.ss,	UTC time of Position
llll.ll,	llll.ll,	Latitude
a,	a,	Hemisphere ”N”/"S”
yyyyy.yy,	yyyyy.yy,	Longitude
a,	a,	”E”/"W”
x,	c--c	GGA: Quality Indicator 0 = fix not available or invalid 1 = No Realtime position, navigation fix 2 = Realtime position, ambiguities not fixed 3 not used 4 = Realtime position, ambiguities fixed GNS: Mode N = No fix. Satellite system not used in position fix, of fix not valid A = Autonomous. Satellite system used in non-differential mode in position fix D = Differential. Satellite system used in differential mode in position fix P = Precise. Satellite system used in precision mode. Precision mode is defined as: no deliberate degradation (such as Selective Availability) and higher resolution code

		(P-code) is used to compute position fix R = Real Time Kinematic. Satellite system used in RTK mode with fixed integers F = Float RTK. Satellite system used in real time kinematic mode with floating integers
xx,	xx,	Number of satellites in use, 00-12
x.x,	x.x,	HDOP
x.x,	x.x,	Antenna altitude above/below mean sea level. Note, if no orthometric height is available the local ell. height will be exported. If the local ell. height is not available either, the WGS84 ell. height will be exported.
M,	not in use	Units of altitude meters (fixed text ”M”)
x.x,	x.x,	Geoidal separation
M,	not in use	Units of geoidal separation meters (fixed text ”M”).
x.x,	x.x,	Age of differential GPS data, null when DGPS not used
xxxx	x.x	GGA: xxxx -> Differential Reference Station ID, 0000-1023 GNS: x.x ->
*hh	*hh	Checksum
<CR>	<CR>	Carriage Return
<LF>	<LF>	Line Feed

Example:

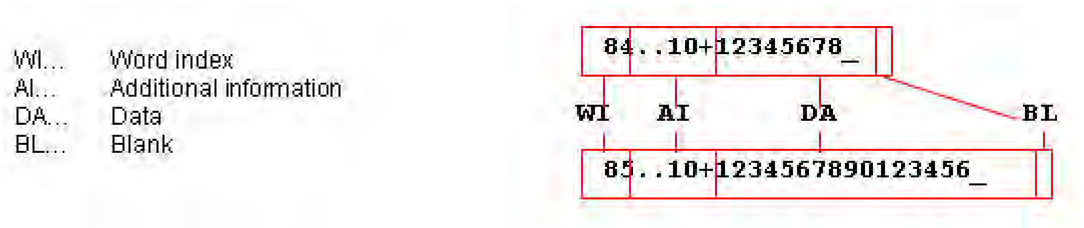
$GPGGA,092525.00,4724.5249318,N,00937.1057283,E,4,07,1.8,474.150,M,,,0.00,0001*23

$GPGNS,134335.00,4724.5287561,N,00937.0830584,E,R,06,1.3,470.377,,0.24,0000*15

GSI format

Points can be imported into the monitoring system using the Leica GSI (Geo Serial Interface) format. The GSI data structure is used for all data transferred between Leica Geosystems electronic survey instruments.

There is a choice between storing 8 characters (places) or 16.



When 16 characters are stored and supported a measurement block is tagged with * at the first position.

Database

Topic contents

Common GeoMoS database management tasks

- Manual export of a database of backup.
- Automatic export of a database.
- Import a database.
- Shrink a database.

GeoMoS SQL database structure

Information on the database structure is available on request.

Check if SQL Server is running

- The icon  will be shown in the system tray if MS SQL Server is running
- If there is a problem the icon  will be shown instead.
- Open the MS SQL Server to check what server it is using. It should show the name of the local machine.

Tip: If the MS SQL Server stops working it may be due to a changed Windows Login password.

Test if database is working

To make sure the GeoMoS database is properly configured run the following command below from the DOS prompt

```
osql - E -Q "use [GeoMoS Database] select * from points"
```

If database is functioning correctly, data will be output to the screen. Otherwise an error message will be given.

Simple SQL queries to extract data

All GeoMoS settings, measurements and results are stored to an open MS SQL database. SQL (**S**tructured **Q**uery **L**anguage) is a standard computer language for accessing and manipulating databases. There are many SQL resources on the internet, for example: http://www.w3schools.com/sql/default.asp

Information on the database structure including SQL queries are available on request.

Extract data from the database

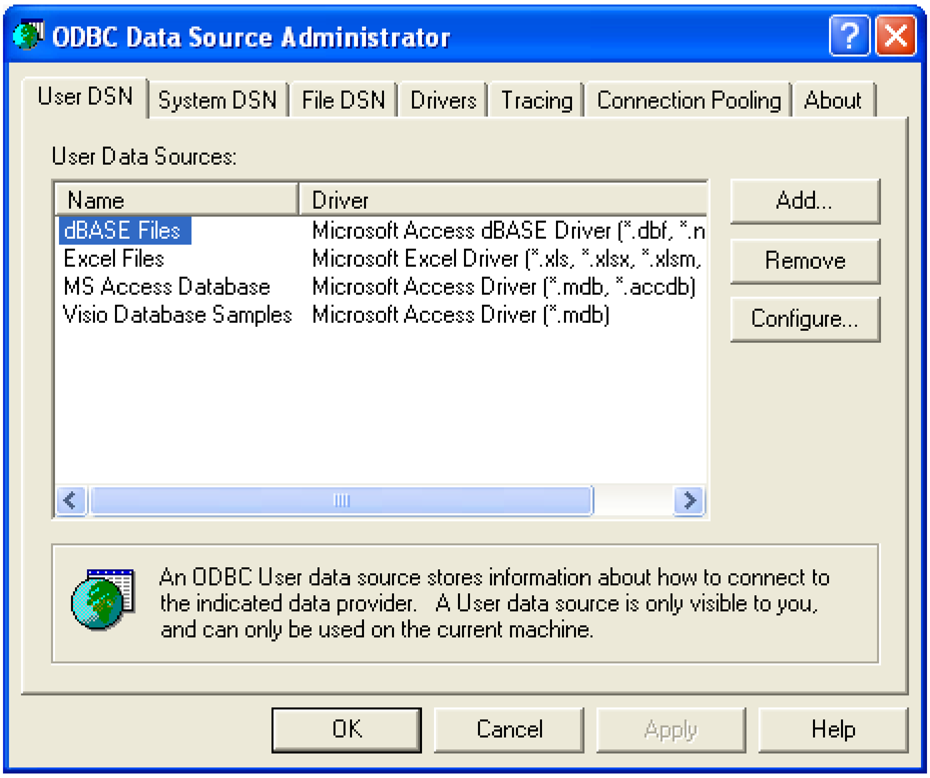
To import data from a SQL database into a another program, two options are available:

- Run a SQL query and import the data using an ASCII file.
- Config ure an ODBC driver and import the data directly.

To configure an ODBC driver

Follow these steps to configure an ODBC driver.

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>Select from Windows the menu Settings, Control Panel, Administrative Tools, Data Sources (ODBC).</td></tr>
<tr><td>2</td><td>The ODBC Data Source Administrator will be displayed.

Select the User DSN tab and press the Add... button.


</td></tr>
<tr><td>3</td><td>Select SQL Server and choose Finish.</td></tr>
<tr><td>4</td><td>Enter for example the name ”GeoMoS Database”, a description and select the server as the name of the local machine (what is shown in the SQL server). Click Next.</td></tr>
<tr><td>5</td><td>Select With SQL Server authentication using a login ID and password entered by the user and enter the correct Login and Password. Click Next.

<table>
<tr><th>GeoMoS version</th><th>Login</th><th>Password</th></tr>
<tr><td>2.0</td><td>geomos</td><td>geomos</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><td>2.1</td><td>geomos2</td><td>geomos_2006</td></tr>
<tr><td>3.0</td><td>geomos2</td><td>geomos_2006</td></tr>
<tr><td>3.1</td><td>geomos2</td><td>geomos_2006</td></tr>
<tr><td>4.0</td><td>geomos2</td><td>geomos_2006</td></tr>
<tr><td>4.1</td><td>geomos2</td><td>geomos_2006</td></tr>
<tr><td>5.0</td><td>geomos2</td><td>geomos_2006</td></tr>
</table>
</td></tr>
<tr><td>6</td><td>Change the default database to your project database "GeoMoS Database". Click Next.</td></tr>
<tr><td>7</td><td>Click Next and then Finish without changing any of the further options.</td></tr>
</table>

Import data (example with MS Excel)

Follow these steps to Import data.

Step	Action
1	Open a new worksheet.
2	Select the menu **Data**, **Import External Data**, **New Database Query…** .
3	The **Choose Data Source** window opens. Go to the **Database** tab, select the data source **GeoMoS Database** and press **OK**.
4	Enter the **login** and **password**. Press **OK**.
5	Select what records you wish to import from each of the tables. Press **Next**.
6	(Optional) Select options to filter the data. Press **Next**.
7	(Optional) Select the sorting order. Press **Next**.
8	Choose **Return data to Excel** to finish. The selected external data will be displayed in a selected MS Excel worksheet. or Choose **View data or edit data in Microsoft Query** to run a query on the data (e.g. to get data only from a certain time period). The **Microsoft Query** dialog will be

	displayed. Refer to the corresponding topic of the Microsoft Query Help for additional information.

Switchbox

Background information

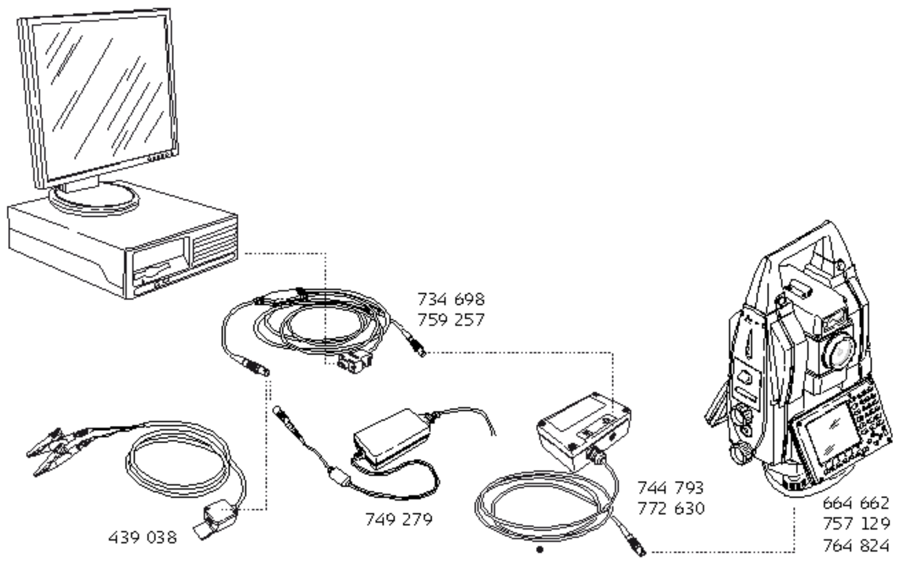
The Switchbox is an essential tool for permanent monitoring. It supports a cold boot for the total station.

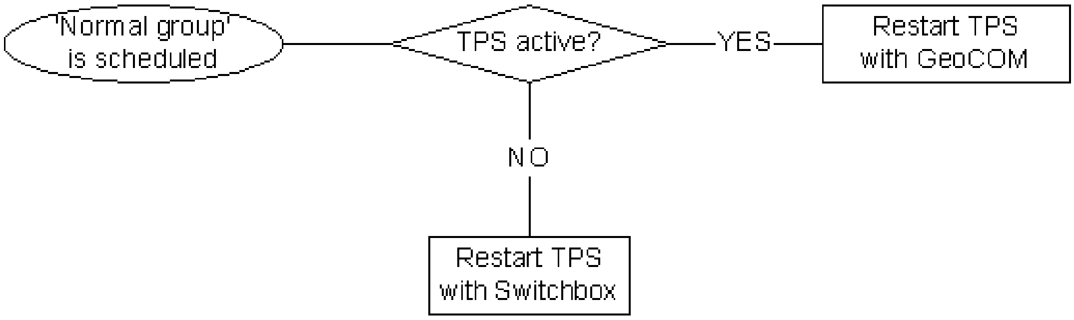
Topic contents

- Use the Switchbox with a total station
- Use the Switchbox with a level
- Switchbox Commands

Use the Switchbox with a total station

Follow these steps to use the Switchbox with a total station.

Step	Action
1	Connect the Switchbox. 
2	Use an external power supply. Do not use the internal battery.
3	Switchbox article number 744793: Set in the **Sensor Setup** dialog the baud rate to **9600** of each total station that is used with the Switchbox. Switchbox article number 772630: Set in the **Sensor Setup** dialog the baud rate to **9600 or 115200** of each total station that is used with the Switchbox.
4	Configure the total stations with the correct baud rate.
5	Select from the menu **Configuration**, **Sensor Location Editor...** . Select the total station that is used with the Switchbox and press **Properties**. Toggle to the **Measurements** tab.
6	Activate the checkbox **Reset theo before normal group**. If this option is set GeoMoS will restart the total station before each normal group.
7	This option is used to enable continuos, uninterrupted operation of the monitoring system.



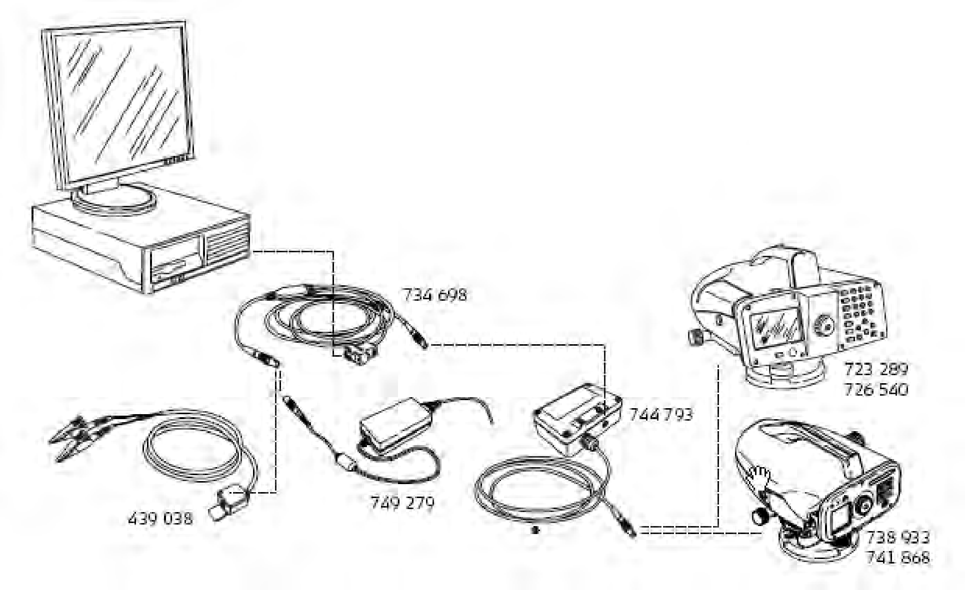
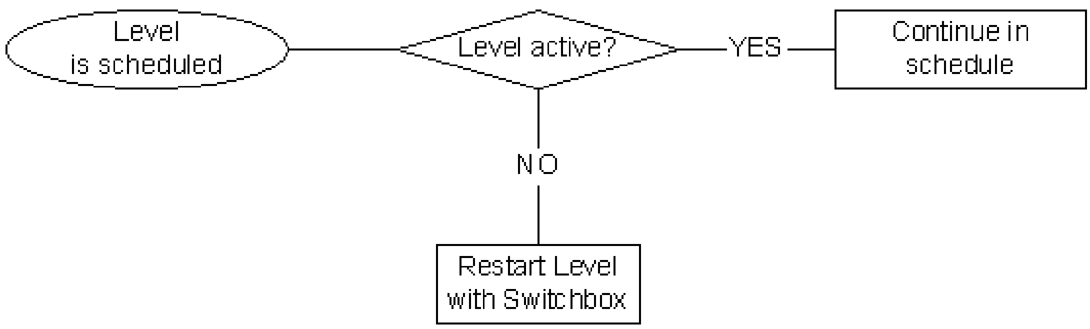
If the total station is active GeoMoS will send before each normal group a command to restart the software. If the total station is not active because of problems with the firmware GeoMoS will send before each normal group a command to the switchbox to cycle the power on the total station.

Warning:

- Use the supported baud rates.
- Do not use the internal battery of the total station.

Use the Switchbox with a level

Follow these steps to use the Switchbox with a level.

Step	Action
1	Connect the Switchbox. 
2	Use an external power supply. Do not use the internal battery.
3	Set in the **Sensor Setup** dialog the baud rate to **9600** of each level that is used with the Switchbox.
4	Configure the levels with the baud rate **9600**.
5	This option is used to enable continuous, uninterrupted operation of the monitoring system. 

Switchbox Commands

<PWR_ON>

<PWR_OFF>

FTP Connections

Background information

With the QueryAndPush tool it is possible to push a database file or SQL results to a FTP Server. The following parameters are available:

Parameter	Description	Example	Additional description
-Q	Query	-Q "c:\temp\Points.sql"	SQL script that includes the SQL query
-F	FTP Server	-F ftp.leica-geosystems-test.com	
-U	User	-U geomos	
-P	Password	-P GzB54QxP	
-D	Directory	-D Temp	
-E	Time of exported data	-E 4	exports the last 4 hours
-E	Time of exported data	-E ALL	exports everything since the last export
-Z	Compressed format	-Z	

To use the QueryAndPush tool

Follow these steps to use the QueryAndPush tool.

Step	Action
1	Define a bat file. The bat file includes all information and parameters to push a database file or SQL results to a FTP Server. **Examples:** a) Database file: "c:\Program Files\Leica Geosystems\GeoMoS\Bin\QueryAndPush.EXE" -F ftp.leica-geosystems-test.com -U geomos -P GzB54QxP -D Temp -E 1 b) SQL query: "c:\Program Files\Leica Geosystems\GeoMoS\Bin\QueryAndPush.EXE" -F ftp.leica-geosystems-test.com -U geomos -P GzB54QxP -D Temp -Q "c:\temp\Points.sql"
2	Select in the Message Configurator Add Application to run the bat file in a command line.
3	Define in the **Measurement Cycle Editor** in the column **Action** the configured application. Actions can be added to be run after the measurement of the point group is finished.

Step	Action
1	Select the menu , .
2	The dialog will be displayed.
3	Select the type of connection.
4	Set the interval for the FTP connection.
5	Enter the correct , and for your FTP server and the directories.
6	Use the button to check the FTP connection is ok.
7	Press the button to save the changes and to close the dialog.

How to Configure the GeoMoS Auto Start

Select your operating system:

- Windows 7
- Windows Vista
- Windows XP

Windows 7

Step 1: Set the password in the user accounts

Step	Action
1	Open the **command-line interpreter**. Select **Start**, type into the search field the command **cmd** and press ENTER.
2	The **command-line interpreter** opens. Enter the command **control userpasswords2** and press **ENTER**.
3	The **User Accounts** dialog opens. **Important**: The User Account dialog can only be opened if the user is logged in with Administrator rights or as "Users" and enters an Administrator password. De-activate the check box "**Users must enter a user name and password to use this computer.**" Press **OK** to confirm or **Cancel** to abort the function.
4	The **Automatically Log On** dialog opens. Enter **user name** and **password**. Press **OK** to confirm or **Cancel** to abort the function.
5	Close the command-line interpreter.

Step 2: Insert GeoMoS Monitor in the Startup folder

Step	Action
1	Select the **Startup** folder.

	C:\Users\<your_user>\AppData\Roaming\Microsoft\Windows\Start Menu\Programs\Startup **Important**: The folder AppData is a hidden folder. Select in the **Windows Explorer** the menu **Organize**, **Folder and Search Options**. Select the **View** tab. Activate the Setting **"Show hidden files, folders, and drives"**.
2	Create a GeoMoS Monitor **shortcut** and **drag** the shortcut into the Startup folder.
3	Open the **command-line interpreter**. Select **Start**, type into the search field the command **msconfig** and press ENTER.
4	The **command-line interpreter** opens. Select the **Startup** tab. Check the GeoMoS Monitor appears.
5	Check with a PC reboot that the settings are working correctly.

Windows Vista

Step 1: Set the password in the registry

Step	Action
1	Open the **Windows Registry**.
2	Go to Computer\HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\WindowsNT\CurrentVersion\Winlogon.
3	Modify the **AutoAdminLogon = 1**.
4	Add the new String Value = **DefaultUserName** and enter the correct values.
5	Add the new String Value =**DefaultPassword** and enter the correct values. **Note:** The password is not stored in encrypted form.

Step 2: Insert GeoMoS Monitor in the Startup folder

Step	Action
1	Select **Start**, **All Programs**, right-click the **Startup** folder, and then click **Open**.
2	Create a GeoMoS Monitor **shortcut** and **drag** the shortcut into the Startup folder.

3	Check with a PC reboot that the settings are working correctly.

Windows XP

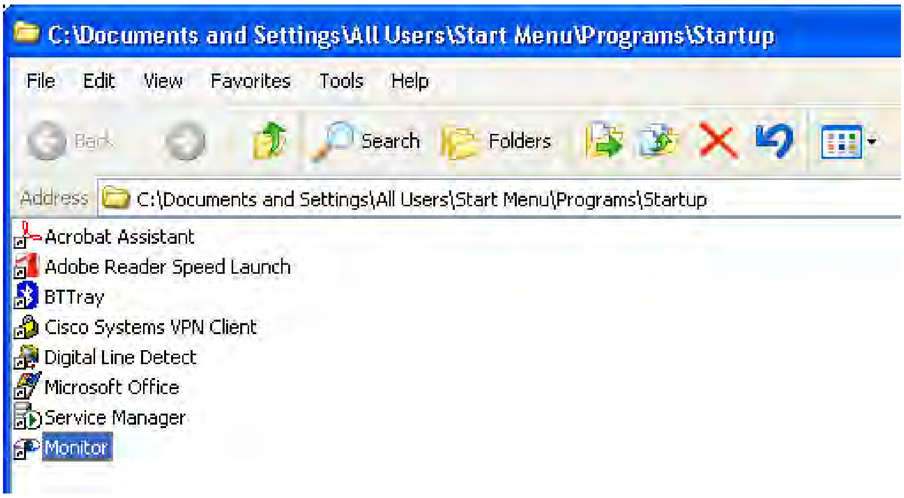
Step 1: Set the password for the Autologon

There are many Autologon tools on the internet, for example Tweak UI for Windows from Microsoft.

Step	Action
1	Install the **Tweak UI** software on your computer and start the software tool.
2	Select in the Tree View the menu **Logon**, **Auto Logon**.
3	Check the **Log on automatically at system startup** box to bypass the initial logon dialog box. **Note:** The password is stored in encrypted form.
4	Press **OK** to confirm or **Cancel** to abort the function.

Step 2: Insert GeoMoS Monitor in the Startup folder

Step	Action
1	Select **Start**, **Programs**, **Startup**.
2	Right-click to open the Context Menu and select **Open All Users**.
3	The Startup folder will be displayed.
4	Drag and drop the **GeoMoS Monitor** into the Startup folder.

	
5	**Close the Startup folder.**
6	Check with a PC reboot that the settings are working correctly.

How to connect GeoMoS Analyzer to a different computer

If Leica GeoMoS Monitor is running on a computer in a network, it is possible to connect to this GeoMoS database with Leica GeoMoS Analyzer from a different computer.

When to use

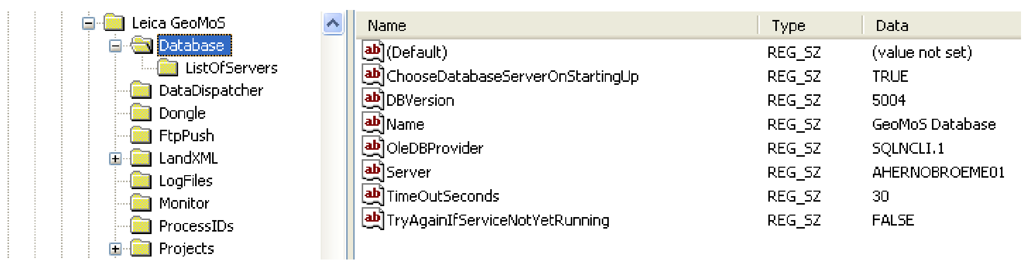
Use this remote connection feature of Leica GeoMoS Analyzer only if

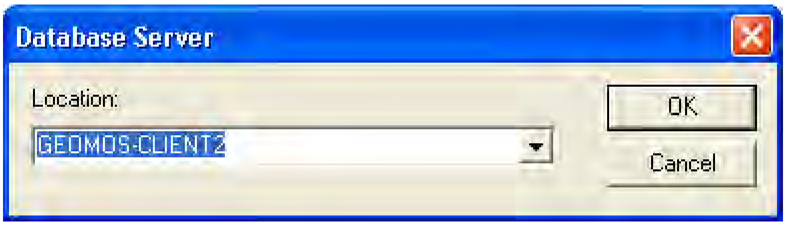
- you are in a network
- the SQL server port 1433 is open
- the GeoMoS Monitor and GeoMoS Analyzer programs have separate dongles

Important: Firewalls can create an additional issues.

Establish a remote connection

Follow these steps to switch on the Analyzer remote connection.

Step	Action
1	Close GeoMoS Monitor.
2	Select in Windows **Start**, **Run...** and type in **regedit**.
3	The Windows Registry opens.
4	Open the path [HKEY_LOCAL_MACHINE\SOFTWARE\LEICA Geosystems\Leica GeoMoS\Database\]
5	Click on the **Database** entry to display the available registry options. 
6	Look for the **ChooseDatabaseServerOnStartingUp** registry entry. Right-mouse click and select **Modify**. Change from the default value from FALSE to **TRUE**.

7	Open GeoMoS Monitor.
8	The dialog **Database Server** appears.  Enter either the **PC name** or the **IP address** of the GeoMoS Monitor computer that you like to connect to. **Note**: For your own computer select "local".
9	Select **OK** and the GeoMoS Analyzer starts with the connection to the selected GeoMoS database in the network.

How to activate an UPS (uninterrupted power supply)

In case the network power is down an uninterrupted power supply (UPS) can power the GeoMoS computer.

Action the GeoMoS Monitor can take

- GeoMoS Monitor shows the message "Power failure" to indicate the that the network power is down.
- The message "Power failure" can be assigned to any action e.g. e-mail or SMS to inform the responsible staff.

Procedure to activate

Follow these steps to setup an UPS to power the GeoMoS computer.

Step	Action
1	Setup the UPS following the user manual.
2	Connect the UPS to the GeoMoS Monitor computer.
3	Most UPS can run an external application if the network power is interrupted. GeoMoS Monitor provides in the GeoMoS BIN directory an external application (UPS_Alarm.exe). Configure the UPS software to start the external application (UPS_Alarm.exe) in case the network power is down.
4	Assign the message "Power failure" in the **Message Configurator** to any action e.g. e-mail or SMS to inform the responsible staff.
5	In case the network power is down the UPS GeoMoS Monitor shows the message "Power failure".

Troubleshooting

How to Configure Dial-Up Connections

Background information

Within GeoMoS, dial-up connections can be used for GeoMoS to Internet service provider (ISP) connections for email. This topic gives you guidelines for how to configure dial-up connections.

The most of the settings to be done will be given by your provider, however note some GeoMoS-specific configurations.

Dial-up connection to an Internet Service Provider (ISP)

Pre-requirements for a dial-up connection to an ISP:

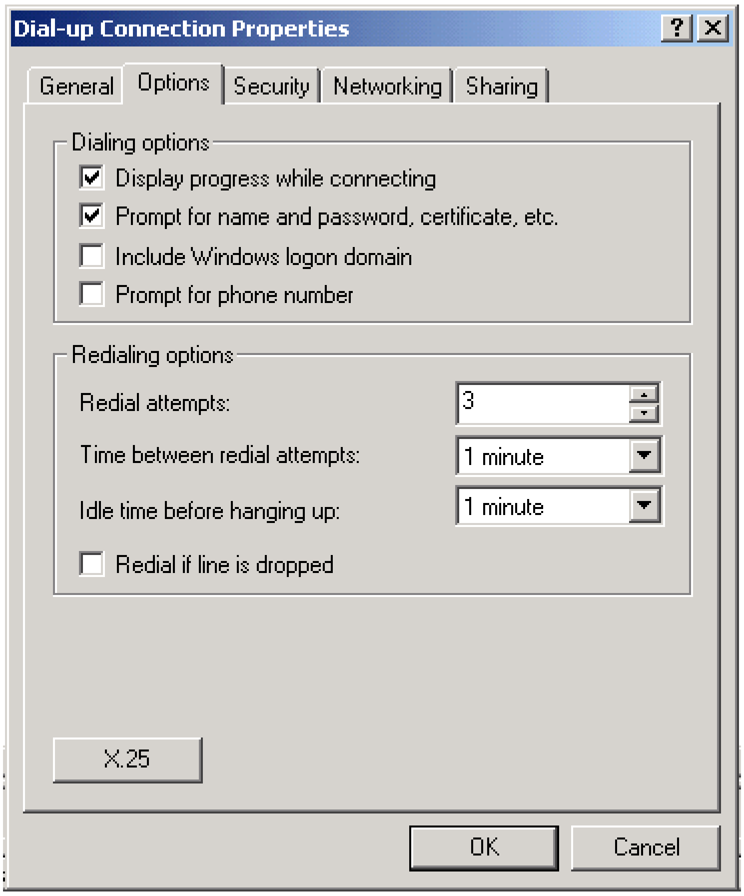
- Modem/ISDN card or similar device attached to the GeoMoS PC.
- a valid account for an Internet Service Provider

If you want to send emails, you need an ISP which gives you access to the Internet. First of all you have to set-up a dial-up connection in Windows. If the dial-up connection is not already installed on the PC where GeoMoS is running, follow the installation guideline from your ISP on how to set-up such a dial-up connection. Beside your ISP's guideline, also note the following setting during the dial-up configuration:

It is important to choose **For all users,** otherwise GeoMoS cannot access this dial up connection.

If the dial-up connection to your ISP is set up, first please try to open the connection manually, to make sure it is working. Select *<Start><Settings><Network Connections>* and choose your previously configured dial-up connection and connect it. If the dial-up process was successful, disconnect the connection manually afterwards.

Now you have to do some GeoMoS related adjustments to the installed dial-up connection. Open the Properties of the dial-up connection which you have installed in the earlier steps. Select *<Start><Settings><Network Connections>* and right click on your previously configured dial-up connection and select *<Properties>*. Select the tab **Options**:



Go to the group box **Redialing Options**. Enter a value for **Redial attempts**. It is recommended to choose 3 redial attempts or more. As the next step, enter a value for the **Idle time before hang up**. In general it is recommended for auto-dial-in connecting software to define a idle time of the telephone line for a hang up. The recommended setting is 1 minute.

Note:

- When connecting to a GeoMoS via a direct dial-up connection, we recommend to always provide the PC name instead of the IP address.
- Leica recommends the 3COM Courier V.Everything modem as preferred modem type for analog dial-up connections.

Communication

Background information

Windows HyperTerminal can be used to check whether the COM ports or TCP/IP are working.

- For Total stations you can send GeoCOM commands and see if/how the sensor responds.
- For GNSS sensors you can test if NMEA strings are received.
- For mobile phones you can test if the standard AT Commands (GSM 7.05 commands SMS) are working.

Important:

Remember to check that GeoMoS is closed so the COM port is free for HyperTerminal.

Test Total Stations

Follow these steps to test the Total Stations.

Step	Action
1	Configure the sensor
2	Basic check with COM ports
3	Advanced test only with Total Stations

Step 1: Configure the sensor

Follow these steps to configure the sensor.

Step	Action
1	Configure the sensor baud rate.
2	Turn the sensor off.

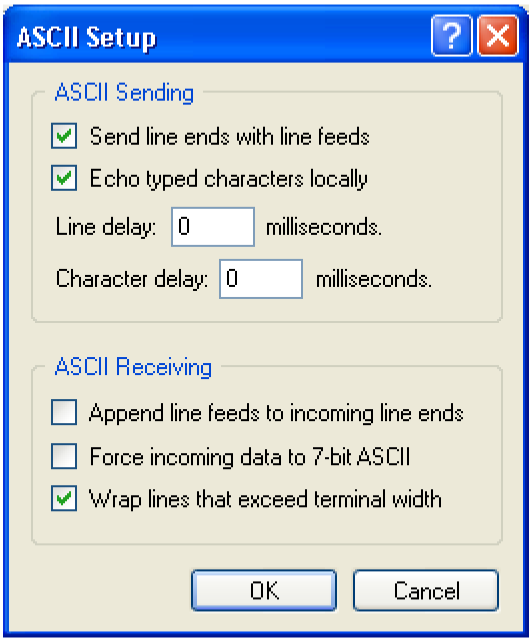
Step 2: Basic check with COM ports

Follow these steps to perform a basic check with COM ports.

Step	Action
1	Select from Windows the menu **Programs**, **Accessories, Communications, HyperTerminal**.
2	The **Connection Description** dialog is displayed. Enter a name and press **OK**. 
3	The **Connect To** dialog is displayed. Select the **COM port** and press **OK**.

<table>
<tr><td></td><td>
</td></tr>
<tr><td>4</td><td>The COM Properties dialog is displayed. Select the correct Baud rate (Bits per second), Data bits = 8, Parity = None, Stop bits = 1, Flow control = None and press OK.

</td></tr>
<tr><td>5</td><td>Select from the menu File, Properties.</td></tr>
<tr><td>6</td><td>The Properties dialog is displayed. Select on the Settings tab the ASCII Setup...</td></tr>
</table>

	button. 
7	The **ASCII Setup** dialog is displayed. **Activate** the check box "Send line ends with line feeds" and "Echo typed characters locally". Press **OK** to confirm the ASCII Setup and Properties dialog. 
8	Send any key via HyperTerminal (for example ”a”).
9	The sensor should turn on.

Step 3: Advanced test only with Total Stations

Follow these steps to perform an advanced test with only Total Stations.

Step	Action
1	Set Total Stations output GSI to RS232.
2	Take a measurement with a GeoCOM command.
3	The measurement should be seen in the HyperTerminal.

Test GNSS NMEA strings

Follow these steps to test GNSS NMEA strings.

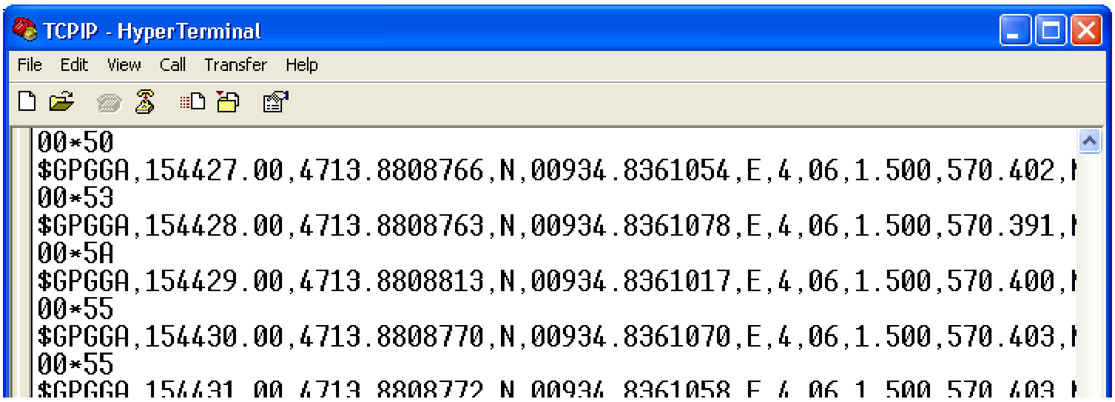
Step 1: Configure the sensor

- Configure the data output of a sensor to a free port.

Step 2: Basic check

Follow these steps to perform a basic check.

Step	Action
1	Select from Windows the menu **Programs**, **Accessories, Communications, HyperTerminal**.
2	The **Connection Description** dialog is displayed. Enter a name and press **OK**. 
3	The **Connect To** dialog is displayed. Select **TCP/IP**, the **Host address**, **Port number** and press **OK**.

<table>
<tr><td></td><td>
</td></tr>
<tr><td>4</td><td>The received data should be seen in the HyperTerminal.

</td></tr>
</table>

Test Siemens MC45 / MC75 mobile phone

Follow these steps to test Siemens MC45 / MC75 mobile phone.

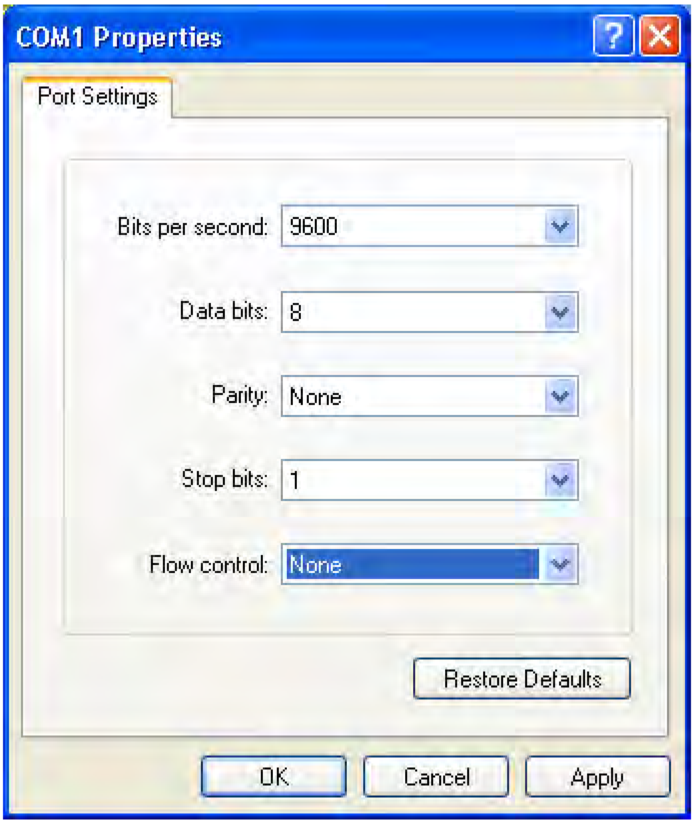
Step 1: Connect the MC45 mobile phone

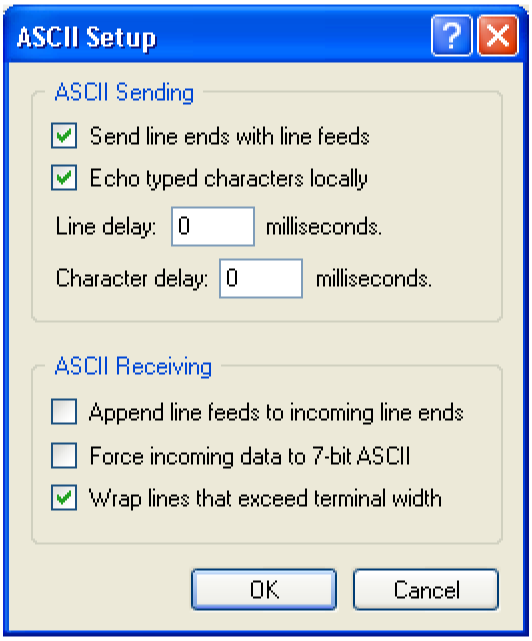
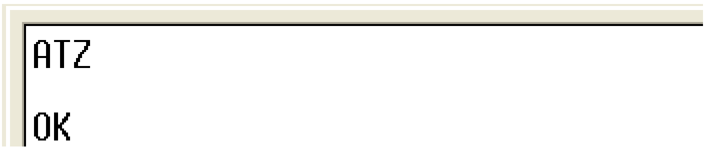
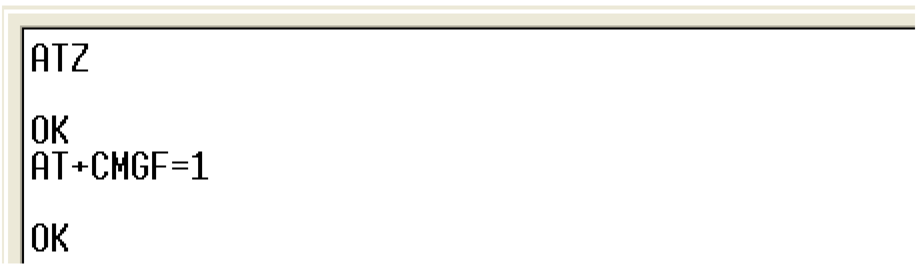
- Configure the data output of the MC45 mobile phone to a port.
- The on/off switch at the program cable GEV171 cable must be set to off.

Step 2: Check the AT Commands

Follow these steps to check the AT commands.

Step	Action
1	Select from Windows the menu **Programs**, **Accessories, Communications, HyperTerminal**.
2	The **Connection Description** dialog is displayed. Enter a name and press **OK**. 
3	The **Connect To** dialog is displayed. Select the **COM port** and press **OK**. 

4	The **COM Properties** dialog is displayed. Select the correct Baud rate (Bits per second), Data bits = 8, Parity = None, Stop bits = 1, Flow control = None and press **OK**. 
5	Select from the menu **File**, **Properties**.
6	The **Properties** dialog is displayed. Select on the **Settings tab** the **ASCII Setup...** button. 
7	The **ASCII Setup** dialog is displayed. **Activate** the check box "Send line ends with line feeds" and "Echo typed characters locally". Press **OK** to confirm the ASCII Setup and Properties dialog.

	
8	Type in the command **ATZ** and press **ENTER**. The MC45 responds with **OK**. (ATZ -> Set all current parameters to user defined profile). 
9	Type in the command **AT+CMEE=1** and press **ENTER**. The MC45 responds with **OK**. This command enables beside the responses "OK" and "ERROR" extended error commands.
10	Type in the command **AT+CMGF=1** and press **ENTER**. The MC45 responds with **OK**. (AT+CMGF -> Select SMS message format). 
11	Send the command **AT+CMGS="+49123456789"** (use an international mobile phone number) and press **ENTER**. ▪ The character **>** appears.

		▪ Type in the text of a SMS, for example **This is my first SMS** and press together the keys **Ctrl** and **Z**. ▪ The SMS will be send to the mobile phone number above.

```
> This is my first SMS→
+CMGS: 49

OK
```

Useful GeoCOM commands (general)

Command	Send	Receive (example)
CSV_GetInstrumentName	%R1Q,5004:	%R1P,0,0:0,"TCA1800"

Useful GeoCOM commands (TPS1000 Series)

Command	Send	Receive (example)
COM_NullProc &endash; Check Communication	%R1Q,0:	%R1P,0,0:0
TMC_GetAngle5 &endash; Read Angles	%R1Q,2107:1	%R1P,0,0:0,4.72000261178,1.465998089451852
TMC_DoMeasure &endash; Angles and Distances (Current Settings)	%R1Q,2008:1,1	%R1P,0,0:0
Measure &endash; Angles and Distances (ATR)	%R1Q,17017:2	Varies (string containing measurements)

Useful GeoCOM commands (TPS1100 and TPS1200 Series)

Command	Send	Receive (example)
COM_NullProc &endash; Check Communication	%R1Q,0:	%R1P,0,0:0
BAP_MeasDistAngle &endash; Angles and	%R1Q,17017:2	Varies (string containing measurements)

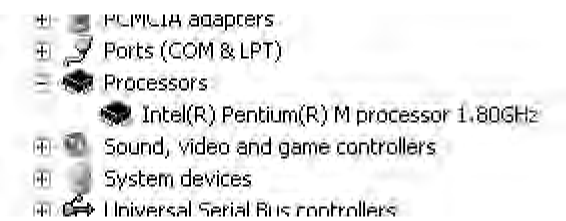
Distances (Current Settings)		

Hyper-Threading Technology

Hyper-threading enables one processor to act like two.

Check if a computer uses the Hyper-Threading Technology

Follow these steps to check if a computer uses the Hyper-Threading Technology.

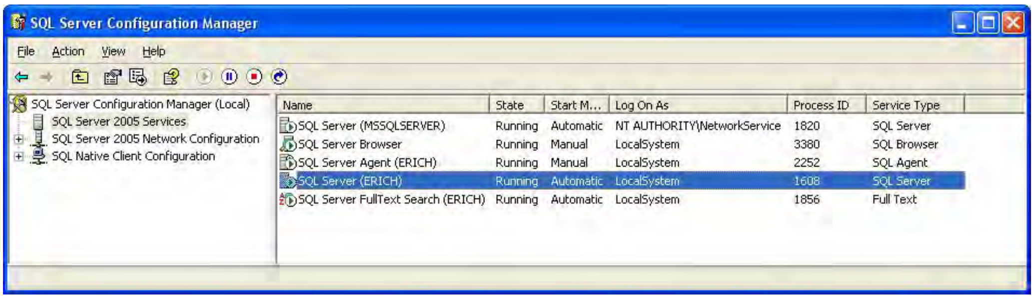
Step	Action
1	Select **Start**, **Settings**, **Control Panel**.
2	Open the menu **System**.
3	The **System Properties** dialog will be displayed.
4	Activate the **Hardware** tab and select the **Device Manager** button.
5	The **Device Manager** dialog appears. Check the total number of **Processors**.  More than one processor indicates the Hyper-Threading Technology.

SQL Server Instance

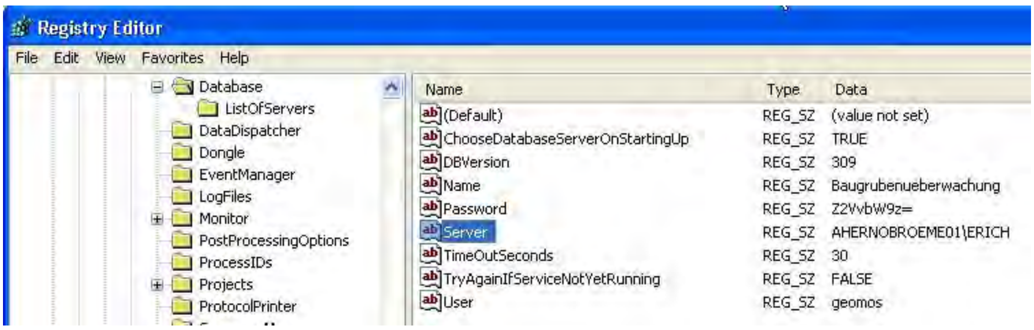
Within GeoMoS, different SQL Server instances can be used for GeoMoS. This topic gives you guidelines for how to configure a different instance that is already installed and used by a different application.

Select Start, Programs, Microsoft SQL Server 2005, Configuration Tools, SQL Server Configuration Manager.

In this example the instance name of the SQL Server is **ERICH**.



You need to configure the instance name **ERICH** in the GeoMoS registry.



[HKEY_LOCAL_MACHINE\SOFTWARE\Leica Geosystems\Leica GeoMoS\Database\]

Server = computer_name\sql_instance

Example: AHERNOBROEME01**ERICH**

How to activate the Sensor_Log.txt file

The Sensor_Log.txt file documents the communication between total stations and Leica GeoMoS Monitor. For support reasons you may be asked to send the Sensor_Log.txt file.

When to use

Activate the Sensor_Log.txt file only

- fo r support **reasons** if the Monitoring team requests the file

Important: Deactivate the Sensor_Log.txt file after the support case is solved because there is no automatic file cleanup and the hard disk will fill up.

Procedure to activate

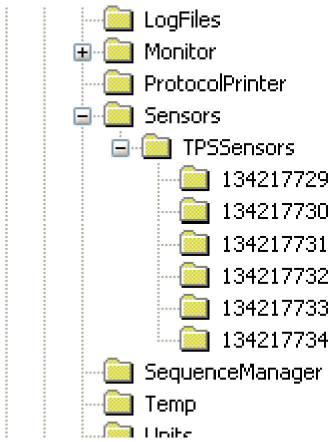
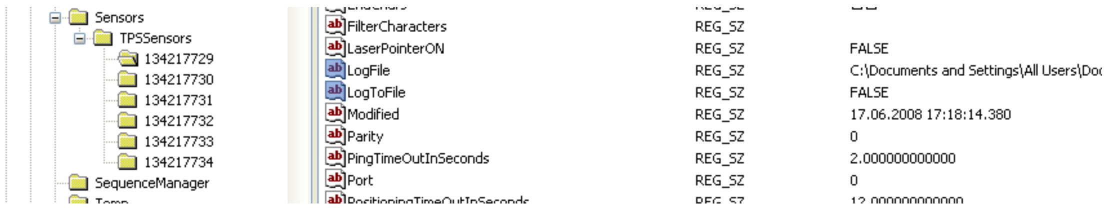
The Sensor_Log.txt file can only be activated and deactivated in the Windows Registry.

Note:

- For each total station the Sensor_Log.txt file must be separately activated and deactivated.
- For each Nivel Bus System there is only one Sensor_Log.txt file, but the Sensor_Log.txt file must be activated on two positions in the Windows Registry. It must be activated for the Nivel with the lowest and the highest ID. (This is also valid for other settings in the bus system, like Timeouts, Number of measurements, etc.)

Follow these steps to activate the Sensor_Log.txt file.

Step	Action
1	Close GeoMoS Monitor.
2	Select in Windows **Start**, **Run...** and type in **regedit**.
3	The Windows Registry opens.
4	Open the path [HKEY_LOCAL_MACHINE\SOFTWARE\LEICA Geosystems\Leica GeoMoS\Projects\<project_name>\Sensors\TPSSensors\]

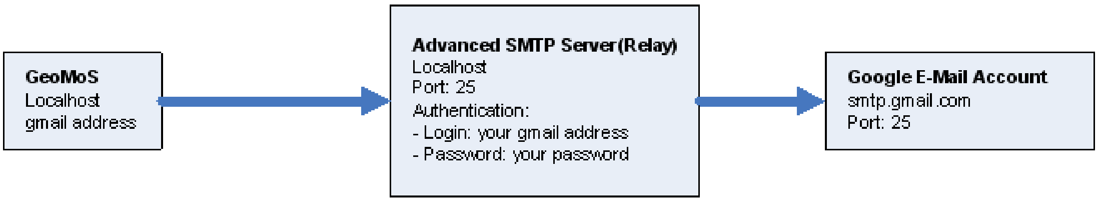
	Your active project name replaces the <project_name>.
5	For each connected total stations there is a separate ID in the registry. For example 134217729, 134217730 .... 
6	Click on the total station ID's to display the available registry options. 
7	Look for the entry **SensorName~** to identify the correct registry ID. The SensorName~ corresponds with the Sensor Name in GeoMoS Monitor.
8	Once you found the correct registry ID change the **LogToFile** from FALSE to **TRUE** and the **LogFile** to an appropriate path.
9	Open GeoMoS Monitor.
10	Start the measurement cycle and check if the Sensor_Log.txt is written.

Deactivate

Change the registry entry **LogToFile** back from TRUE to **FALSE**.

Configure GeoMoS to send e-mail to an address that requires authentication (e.g. GMail or Yahoo)

Overview of procedure



Procedure

Follow these steps to Configure GeoMoS to send email to a SMTP server that requires authentication (e.g. GMail or Yahoo).

Step	Action
1	Download and install a SMTP Server
2	Configure GeoMoS
3	Configure Advanced SMTP Server
4	Send a test e-mail

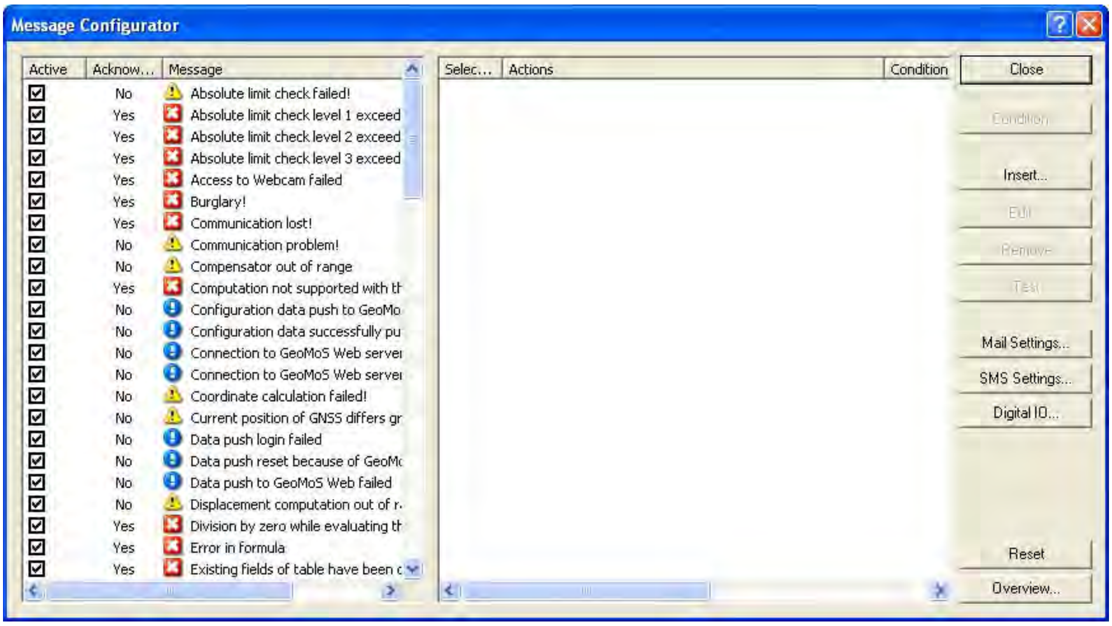
1: Download and install a SMTP Server

A SMTP Server is required to receive e-mails from GeoMoS and send them to an e-mail account. For this example we will download a free SMTP Server trial version from a 3rd party: http://www.softstack.com/advsmtp.html. This trial version of SMTP Server is free for 30 days, after this time you will have to register and pay a single-user licence fee.

2: Configure GeoMoS

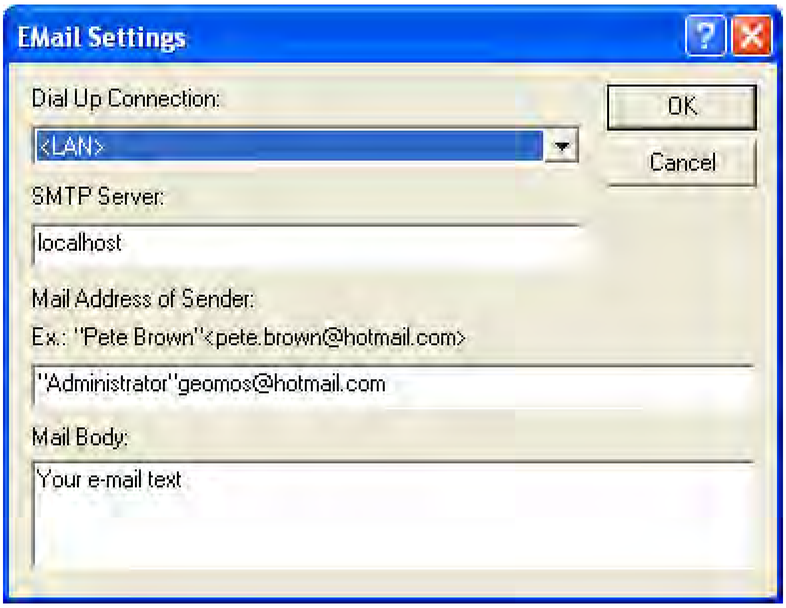
Follow these steps to configure GeoMoS.

Step	Action
1	Open **GeoMoS Monitor**. Go to **Configuration** > **Message Configurator**.
2	The Message Configurator dialog box will open. Press the Mail Settings button.

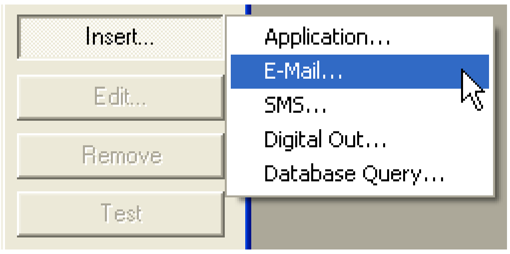


3 Configure the Mail Settings as shown in the screen shot.

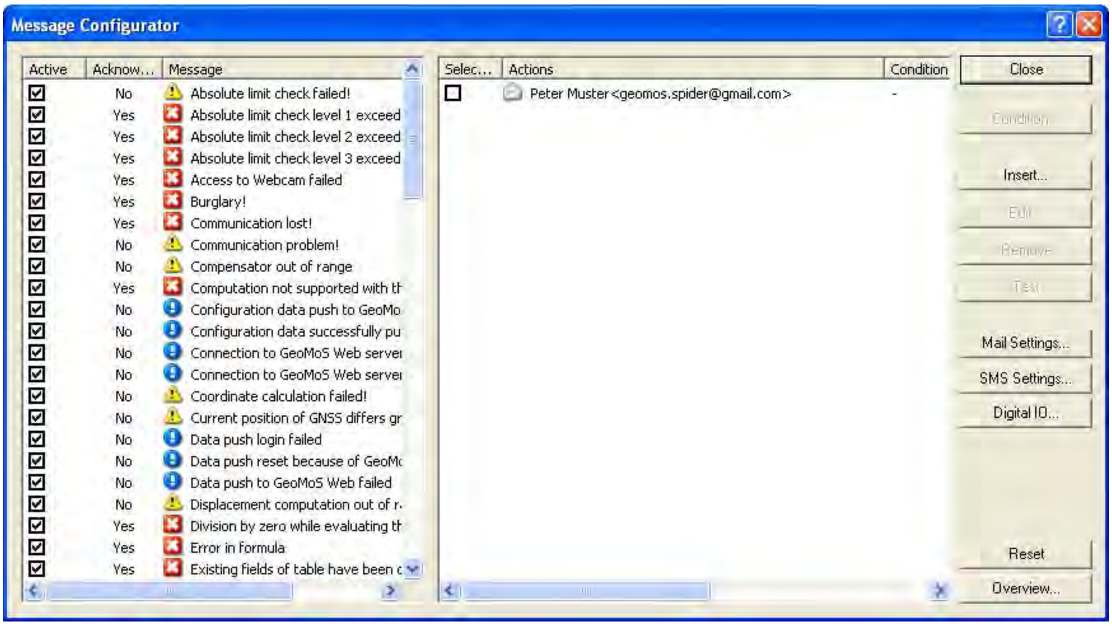
- **SMTP Address:** localhost
- **Mail Address of Sender:** Enter an e-mail address of your choice.
  E.g.”r;Administrator”geomos@hotmail.com
- **Mail Body:** Enter the content of that will be sent in the E-mail.



- Click OK to save. You will return to the Message Configurator window.

<table>
<tr><td>4</td><td>In the Message Configurator window press the button Insert and select E-Mail.
</td></tr>
<tr><td>5</td><td>Add an e-mail recipient
Name: Enter the name of the recipient
Address: Enter the e-mail address of the recipient
Subject: Enter a subject description. This is the e-mail subject heading.

Click OK to save. You will return to the Message Configurator window.</td></tr>
<tr><td>6</td><td>The details of the e-mail recipient are now shown as an action in the Message Configurator.</td></tr>
</table>

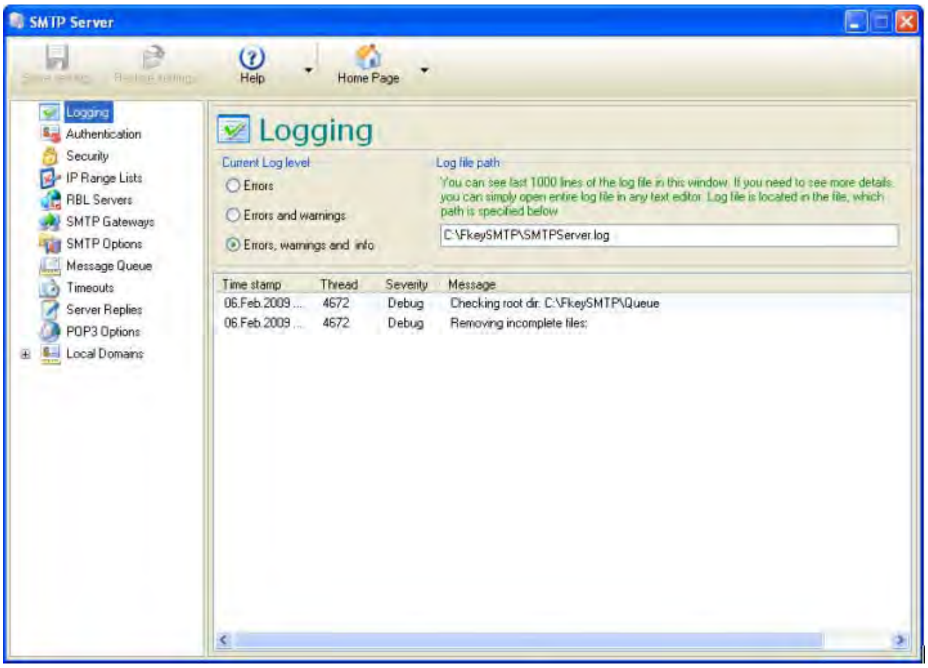


7	Close the Message Configurator.

3: Configure Advanced SMTP Server

Follow these steps to configure an Advanced SMTP Server

Step	Action
1	Open the **SMTP Server: Windows Start** > **All Programs** > **Advanced SMTP Server** > **Advanced SMTP Server**. The **SMTP Server** window opens

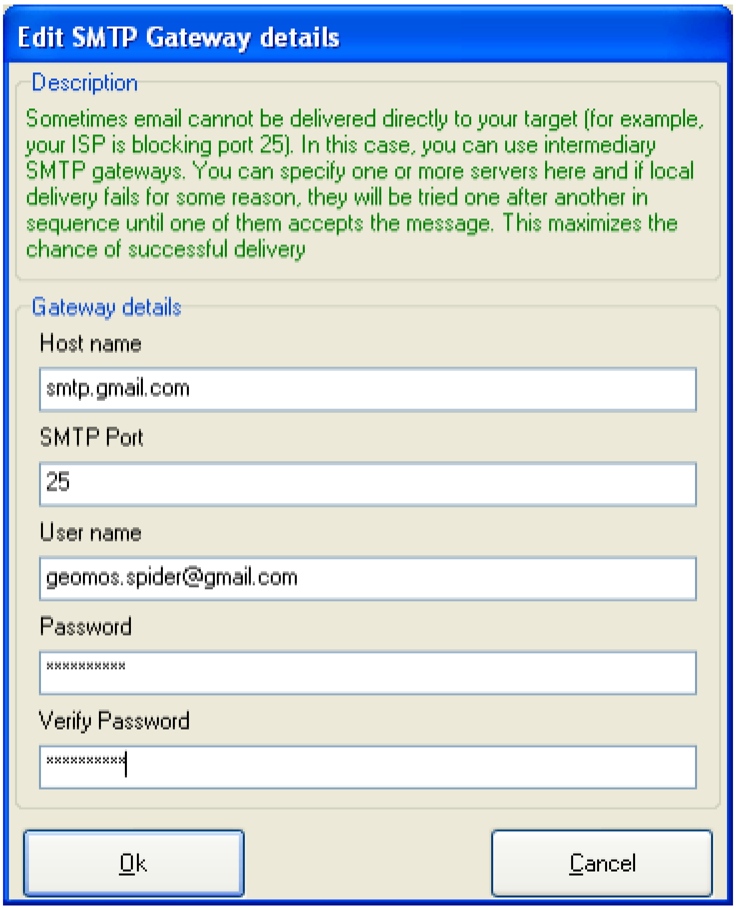


2 Select **SMTP Gateway** in the left hand tree view.

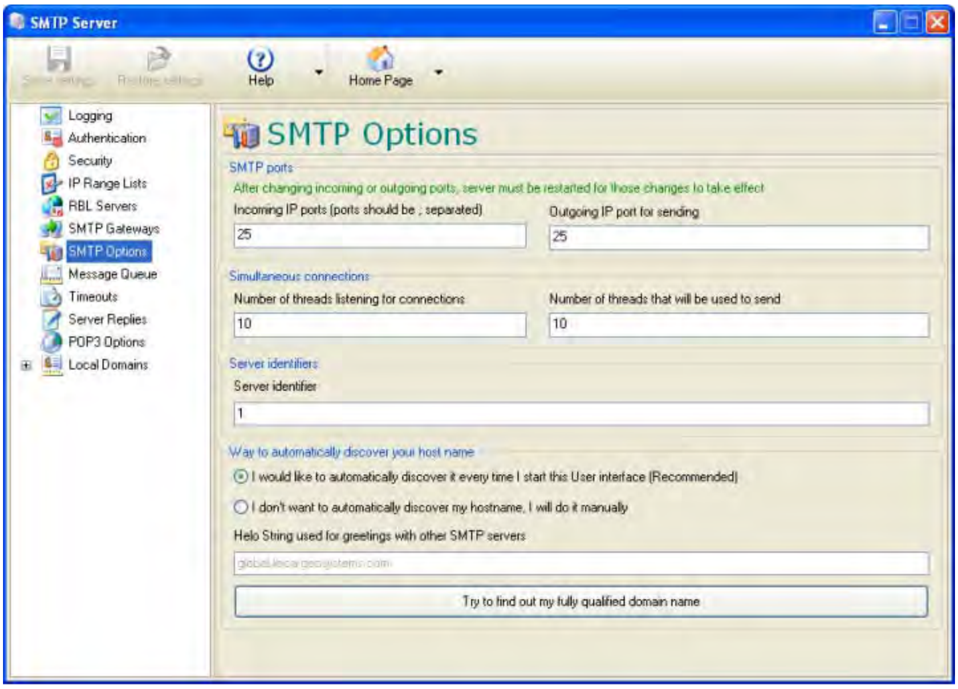
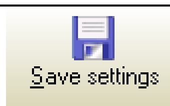
- Press the **Check if port 25 is open by your ISP** button.

3 Press **Add** to add a new SMTP Gateway.

- Enter the SMTP Gateway details.

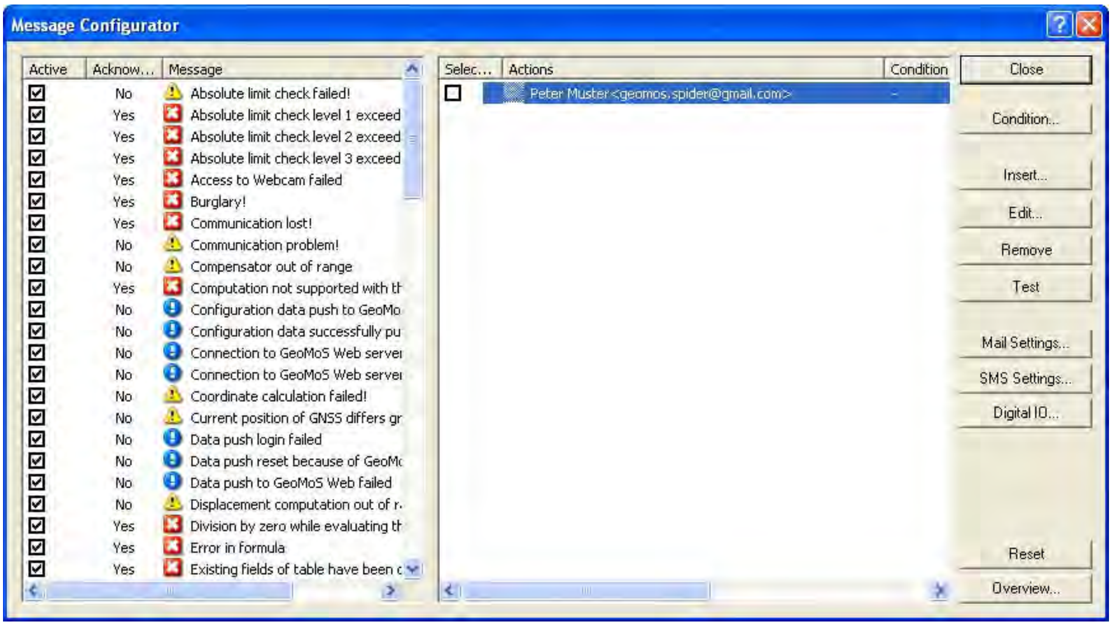


- Press OK to save. The new SMTP Gateway will be visible in the main SMTP Server window.

<table>
<tr><td></td><td>
</td></tr>
<tr><td>4</td><td>Select SMTP Options in the left hand tree view and configure the following options as shown in the screen shot.

</td></tr>
<tr><td>5</td><td>Press the save settings button 
. The SMTP settings have now been changed.</td></tr>
<tr><td>6</td><td>Press Yes to restart the SMTP server process for the changes to take effect.</td></tr>
<tr><td>7</td><td>Close the SMTP Server and continue to Step 4: Send a test email.</td></tr>
</table>

4: Send a test e-mail

Follow these steps to send a test e-mail from GeoMoS.

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>Open GeoMoS Monitor. Go to Configuration > Message Configurator.</td></tr>
<tr><td>2</td><td>Select the configured e-mail and press the Test button.

</td></tr>
<tr><td>3</td><td>If GeoMoS was able to send the e-mail then the following dialog box will appear.

</td></tr>
<tr><td>4</td><td>Check your e-mail account to ensure that the test mail arrived.

The e-mail may be in the spam folder. Select the e-mail and set to not spam.</td></tr>
<tr><td>5</td><td>GeoMoS is now configured to send e-mail to an address that requires authentication.</td></tr>
</table>

How to configure a DynDNS account for ComBoxes

Background information

To use ComBoxes we recommend to utilise domain name services (DNS). A domain name service provider is Dynamic Network Services Inc. Among other things they offer you superior domain name services (**DynDNS**).

Each ComBox needs a unique host name (domain name) which can be created within a DynDNS account. This host name points to your dynamic IP address of your ComBox's SIM card.

Such an account must be organised locally prior to installation of a ComBox.

Procedure to activate

Follow these steps to configure a DynDNS account.

Step	Action
1	Open with a web browser following web page: **www.dyndns.com**
2	Select the tab **Services & Prices** to get an overview about the offered services: ▪ DynDNS Free (This account is for free and the most popular, it allows to create five hostnames) ▪ DynDNS Pro (This account with low costs allows to create up to 25 hostnames. Also you have more robust service features and support) ▪ DynDNS Custom (This account with costs is an all-in-one managed DNS hosting solution for top level domains)
3	Create a new **DynDNS account**: Pressing the button **Sing in** you find following link **Create a new account** a. Type in following information: ▪ Define a **Username** (this name is needed for the DynDNS settings in the ComBox Manager) ▪ Define a **Password** (this password is needed for the DynDNS settings in the ComBox Manager) ▪ Confirm the Password ▪ Define an **E-mail address** ▪ Confirm the E-mail address

	At the end you have to enter a **security number** from an image and agree with the **acceptable use policy**. b. If all information is inserted you can press the button **Create Account**. c. You will get an e-mail to your e-mail account to verfiy your DynDNS account.
4	Create a new **host name** for your ComBox: a. If you are not already logged into your account then press the button **Sign in** and enter your Username / Password. b. Press the link **Add Host Services** to add a new hostname c. Define a **host name** for your ComBox d. Select a **suffix** in the list box for your domain name e. Press the link **Your current location's IP address is ###.###.###.###** to insert a first IP address. f. Press the button **Add To Cart** g. Press the button **Next** h. Press the button **Activate Services** i. **Log out** Now your host name is activated and ready to be used for your ComBox configuration.

System Requirements

System Requirements

The following system requirements are necessary to run GeoMoS Monitor.

Min. Hardware:

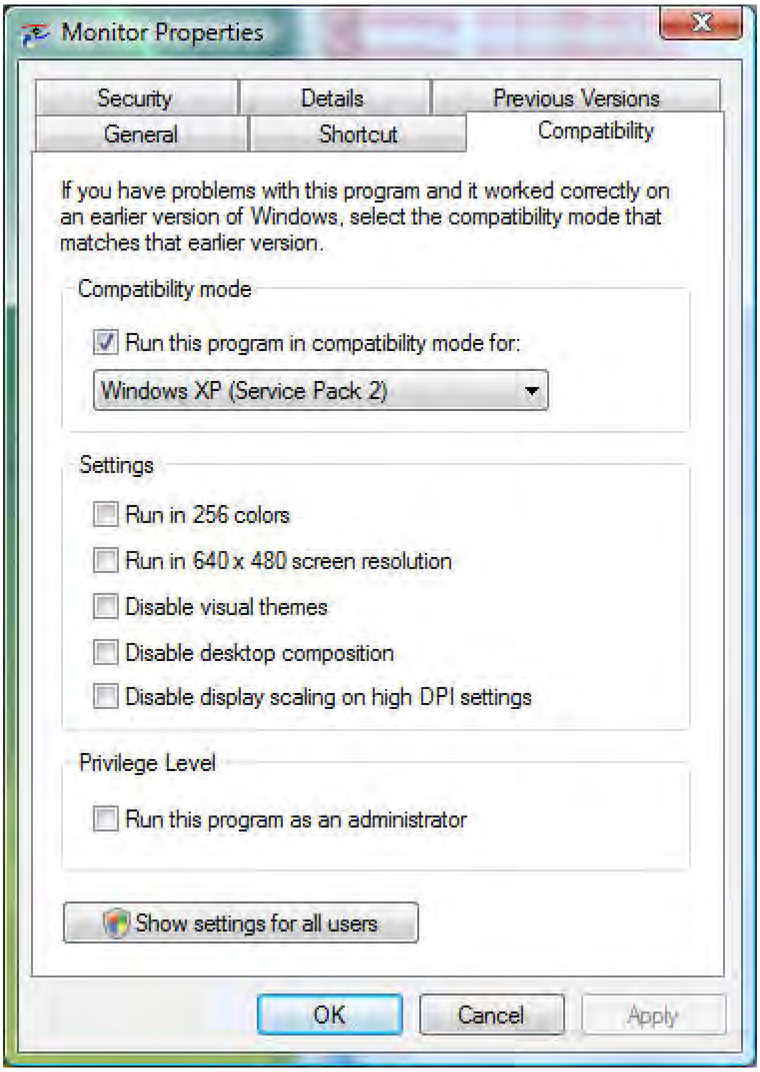
- 512 MB RAM (1 GB or more is recommended)
- Processor: Pentium III or higher is recommended
- Processor speed: 600 MHz (1 GHz or more is recommended)
- 10 GB hard disk space (50 GB or more is recommended)
- DVD ROM drive

Operating System:

- Wind ows 7
- Windows Vista (SP1)
- Windows XP Professional (SP3)
- Windows 2003 Server (SP2)

Important Notes:

- **All operating systems**: Disable in the control panel the power options **system standby**, **system hibernate** and **turn off hard disks**.
- **Windows Vista only**: Activate in the Monitor Properties the **compatibility mode** for the Monitor application.



Other:

- Internet Explorer 6.0, SP1 (or higher)
- Printer
- COM ports sensor and computer connections
- Data transfer via cable, radio link, etc.
- UPS (Uninterrupted Power Supply)

Supported Sensors:

- Leica TPS System 1000
- Leica TPS 1100 Professional Series
- Leica TPS 1200 Professional Series

- Leica TM30/TS30 Series

  Important: Switch off the TPS sleep mode for monitoring applications.

- Leica GPS System 500
- Leica GPS System 1200
- NIVEL20, NIVEL200
- STS DTM Meteorological Sensors
- Leica DNA
- Leica Sprinter
- Leica Disto, DIMETIX disto
- Leica GNSS Spider (RT and PP Positioning Products)
- GPS NMEA (GGA and GNS format)
- Campbell Scientific Datalogger with analog geotechnical sensors

Coordinate System Manager

Coordinate System Management

Within LGO the user can work in the global coordinate system (*WGS1984*) or in a local coordinate system. The local coordinate system may be a geodetically defined system or it may be a simple grid system with neither an Ellipsoid nor a Projection associated with it.

The Coordinate System Management is linked to a database, which is responsible for storing the parameters. This database is independent from the Project database.

Select from the list below to learn more about Coordinate System Management:

Coordinate Systems

Transformations

Ellipsoids

Projections

State Plane Zones

Geoid Models

Country Specific Coordinate System (CSCS) Models

Coordinate System

Coordinate Systems: Overview

A Coordinate System provides the information necessary to convert coordinates to different representations (*Cartesian, Geodetic, Grid*) and to transform coordinates between the *WGS1984* and the *Local* system. A Coordinate System may be attached to a Project.

One or more of the following parameters define a Coordinate System:

Transformations

Ellipsoids

Projections or State Plane Zones

Geoid Models

Country Specific Coordinate System (CSCS) Models

Select from the index below to learn how to manage Coordinate Systems:

Add a New Coordinate System

Delete a Coordinate System

Coordinate System Properties

Coordinate System Properties: General

Add a New Coordinate System

Enables you to define a new Coordinate System for further use in a Project. Transformations, Ellipsoids, Projections and Geoid Models must be previously defined in order to be able to select them from the lists.

Step	Action
1	Right-click on Coordinate Systems in the Tree-View and select **New**.
2	Enter the **Name** of the Coordinate System.
3	Select a **Transformation** from the list. Transformations may be calculated using **Leica LGO Datum/Map** or in the case of a Classical 2D and 3D, manually entered. See also Add a New Transformation.
4	If you have selected a Transformation that was previously calculated using Datum/Map you may choose how to distribute the **Residuals**. The distribution weighting may be in relation to the *distances* between the point to be transformed and the control points or by using a *Multi-quadratic* interpolation approach. *No distribution* will be selected by default.
5	Select an **Ellipsoid** for the *Local* system (System B) from the list. Note: An Ellipsoid cannot be selected if it is already defined in the Transformation or is not required if you are using a One Step or an Interpolation Transformation.
6	Select a **Projection**, or a **Zone** from the list. Except for the Customized Projections and the State Plane Zones, which are hardwired, Map Projections have to be defined before they become available in the list. See also: Add a New Projection. Note: To switch between Projections and State Plane Zones right-click on the background of the Property-Sheet and select between **Projections** and **Zones**. A Projection is not required if you are using a One Step or an Interpolation Transformation.
7	If required select a **Geoid Model** from the list. Refer to Coordinate System Properties: General for the requirements to add a valid geoid model to the new coordinate system.
8	If required select a **CSCS Model** (**C**ountry **S**pecific **C**oordinate **S**ystem Model) from the list. CSCS models have to be defined before they become available in the list. See also: Add a new CSCS Model.
9	Enter the optional **Note** to describe the Coordinate System.

10	Press **OK** to confirm or **Cancel** to abort the function.

Select from the index below to learn how to manage Coordinate Systems:

Coordinate System: Overview

Delete a Coordinate System

Coordinate System Properties

Coordinate System Properties: General

Delete a Coordinate System

Important Information:

- Coordinate Systems that are attached to a Project are indicated by ⚠ and cannot be deleted.
- The Coordinate Systems *WGS1984* and *None* are hardwired and can neither be deleted nor modified.

Delete a Coordinate System:

Follow these steps to delete a Coordinate System

Step	Action
1	Right-click on a Coordinate System in the Tree-View or Report-View and select **Delete**.
2	Press **Yes** to confirm or **No** to exit without deleting.

Select from the index below to learn how to manage Coordinate Systems:

Coordinate System: Overview

Add a New Coordinate System

Coordinate System Properties

Coordinate System Properties: General

Coordinate System Properties

Background Information:

This Property-Sheet enables you to display/ edit the Coordinate System Properties.

A Coordinate System can be attached to a project by selecting it in the Project Properties: Coordinates page. If a coordinate system other than *WGS1984* or *None* is attached, coordinates can be displayed in either *WGS84* or *Local*.

Important Information:

- The Coordinate System *WGS1984* is hardwired and can neither be deleted nor modified. It is the default coordinate system on GPS instruments.
- The Coordinate System *None* is also hardwired and can neither be deleted nor modified. It is the default coordinate system on TPS 1200 instruments.

Edit Coordinate System Properties:

Follow these steps to edit Coordinate System Properties.

Step	Action
1	Right-click on a Coordinate System in the Explorer-View or Tree-View and select **Properties**.
2	Make your changes in the page General. Only the fields with white background may be edited at that particular instant.
3	Press **OK** to confirm or **Cancel** to abort the function.

Select from the index below to learn how to manage Coordinate Systems:

Coordinate System: Overview

Add a New Coordinate System

Delete a Coordinate System

Coordinate System Properties: General

Coordinate System Properties: General

This Property-Page enables you to display/edit the Coordinate System Properties.

Field	Description
Name	Name of Coordinate System.
Transformation	Displays the selected Transformation. Transformations may be calculated using **Leica LGO Datum/Map** or in the case of a Classical 2D and 3D, manually entered. See also Add a New Transformation.
Trans. Type	Displays the type of the Transformation selected above. Its height mode (Ellipsoidal or Orthometric) is displayed, too.
Residuals	For Transformations calculated using **Leica LGO Datum/Map** you might choose how to distribute the residuals. The distribution weighting may be in relation to the *distances* between the point to be transformed and the control points or by using a *Multi-quadratic* interpolation approach. *No distribution* is selected by default.
Local Ellipsoid	Displays the Ellipsoid of the Local System (System B). Most of the commonly used Ellipsoids are hardwired. However you may define your own Ellipsoid. See Add a New Ellipsoid. **Note:** An Ellipsoid cannot be selected if it is already defined in the Transformation or is not required if you are using a One Step or an Interpolation Transformation.
Projection	Displays the Map **Projection** or the State Plane **Zone**. Except for the Customized Projections and the State Plane Zones, which are hardwired, the Map Projections have to be pre-defined before they become available in the list. See also: Add a New Projection. **Note:** To switch between Projections and State Plane Zones right-click on the background of the Property-Sheet and select between **Projections** and

	Zones. A Projection is not required if you are using a One Step or an Interpolation Transformation. When using a Stepwise or a Two-Step transformation the Projection is already defined.
Proj. Type	Displays the type of the above selected Projection. See Projections for a complete list of all available Projection Types.
Geoid Model	Displays the Geoid Model. Geoid Models are not hardwired and need to be defined before they become available in the list. See also Add a New Geoid Model. **Note:** A geoid model, which is intended to be applied to a coordinate system defined on a local ellipsoid has to generally be based upon the same local ellipsoid. **One Step**, **Interpolation**, **Stepwise** and **Two Step** transformations cannot be combined with local geodetic geoid models as these transformation types convert directly to local grid. Geoid models based on local grid are allowed with these transformation types, though. Use of geoid models based upon the WGS84 ellipsoid: Additionally, global geoid models which are based on the WGS84 ellipsoid can be attached to a coordinate system which itself is defined on a local ellipsoid different to the WGS84 ellipsoid if the following conditions are met: • The transformation is of type *Classical 3D*, *One Step*, *Two Step* or *None*. • The height mode of the transformation is *Ellipsoidal*, which means that the transformation results in local ellipsoidal heights.

	The resulting WGS84 geoid separations will always be converted to the local system and be stored as local geoid separations. The orthometric heights will be calculated by applying the geoid separations directly to the WGS84 ellipsoidal heights.
Geoid Model	Displays the Geoid Model. Geoid models need to be defined before they become available in the list. See also: Add a New Geoid Model. Note: Displays the optional Note to describe the Coordinate System.
CSCS Model	Displays the Country Specific Coordinate System Model (CSCS Model). CSCS models need to be defined before they become available in the list. See also: Add a new CSCS Model. **Note:** Displays the optional Note to describe the Coordinate System.
Note	Enter an optional note to describe the Coordinate System. The note may be up to 48 characters long.
Last Modified	Displays the Date and Time the Coordinate System was last modified.

Select from the index below to learn how to manage Coordinate Systems:

Coordinate System: Overview

Add a New Coordinate System

Delete a Coordinate System

Coordinate System Properties

Transformation: Overview

Background Information:

The Transformation is normally used to transform coordinates from *WGS1984* to a *Local* system or vice versa. However it may also be used to perform a Transformation between two local systems.

A Transformation is a set of parameters that describe the conversion of coordinates from one system to another.

Transformation parameters are handled using the Coordinate System Management, but they may be determined with the **LGO Datum/Map** tool.

The following Transformation approaches are available:

- Classical 2D
- Classical 3D
- One Step
- Stepwise
- Interpolation
- Two Step

Select from the index below to learn how to manage Transformations:

- Add a New Transformation
- Delete a Transformation
- Transformation Properties

Related topics:

Which approach to use?

Classical 2D

Background Information:

The Classical 2D transformation approach allows you to determine parameters for transforming the position coordinates (Easting and Northing) from one grid system to another grid system. No parameters for the height will be calculated.

This transformation determines 4 parameters (2 shifts Easting and Northing, 1 Rotation and 1 Scale factor).

- The Classical 2D transformation may only be used to export local Coordinates to an ASCII file. A Classical 2D transformation can not be used in a Project.

Other transformation approaches:

Classical 3D

One Step

Two Step

Interpolation

Stepwise

Which approach to use

Classical 3D

Background Information

The Classical 3D transformation approach creates transformation parameters using a rigorous 3D Classical method.

Basically, the method works by taking the Cartesian coordinates of the GPS measured points (WGS84 ellipsoid) and comparing them with the Cartesian coordinates of the local coordinates. From this, **Shifts**, **Rotations** and a **Scale factor** are calculated in order to transform from one system to another.

The Classical 3D Transformation approach allows you to determine a maximum of 7 transformation parameters (3 shifts, 3 rotations, and 1 scale factor). However the user can select the parameters to be determined.

The Classical 3D transformation allows the choice of two different transformation models: Bursa-Wolf or Molodensky-Badekas.

For the Classical 3D transformation method, we recommend that you have at least three points for which the coordinates are known in the local system and in WGS84. It is possible to compute transformation parameters using only three common points but using four produces more redundancy and allows for residuals to be calculated.

The Advantage

- The advantages of this method of calculating transformation parameters are that it maintains the accuracy of the GPS measurements and may be used over virtually any area as long as the local coordinates (including height) are accurate.

The Disadvantage

- The disadvantage is that if local grid coordinates are desired, the local ellipsoid and map projections must be known. In addition if the local coordinates are not accurate within themselves, any new points measured using GPS may not fit into this existing local system once transformed.
- In order to obtain accurate ellipsoidal heights the Geoid separation at the measured points must be known. This may be determined from a geoidal model. Many countries do not have access to an accurate local geoidal model. See also Geoid Model.

Other transformation approaches:

Classical 2D

One Step

Two Step

Interpolation

Stepwise

Which approach to use

One Step

Background Information:

This transformation approach works by treating the height and position transformations separately. For the position transformation, the WGS84 coordinates are projected onto a temporary Transverse Mercator projection and then the shifts, rotation and scale from the temporary projection to the "real" projection are calculated.

The Height transformation is a single dimension height approximation.

Because of the way in which the position transformation approach works it is possible to define a transformation without any knowledge of the local map projection or local ellipsoid.

As with the Interpolation and Stepwise approaches, the height and position transformations are separate and therefore errors in height do not propagate into errors in position. Additionally, if knowledge of local heights is not good or non-existent you can still create a transformation for position only. Also, the height points and position points do not have to be the same points.

Because of the way in which the transformation works it is possible to compute transformation parameters with just one point in the local and WGS84 system.

The combinations of the number of points in position and the position transformation parameters that can be calculated from them are as follows:

No. of position points	Transformation Parameters Computed
1	Classical 2D with shift in X and Y only
2	Classical 2D with shift in X and Y, Rotation about Z and Scale
more than 2	Classical 2D with shift in X and Y, Rotation about Z, Scale and Residuals

The number of points with height included in the transformation directly affects the type of height transformation produced.

No. of height points	Height transformation based on
0	No height transformation
1	Constant height transformation

2	Average constant between the two height points.
3	Plane through the three height points
more than 3	Average plane

The Advantages:

- The advantages of this method are that transformation parameters may be computed using very little information. No knowledge is needed of the local ellipsoid and map projection and parameters may be computed with the minimum of points. Care should be taken however when computing parameters using just one or two local points as the parameters calculated will only be valid in the vicinity of the points used for the transformation.

The Disadvantage:

- Disadvantages of this approach are the same as for the Interpolation approach in that the area of the transformation is restricted to about 10km square (Using 4 common points).

Other transformation approaches:

Classical 3D

Classical 2D

Two Step

Interpolation

Stepwise

Which approach to use

Two Step

Background Information:

This transformation approach works by treating the height and position transformation separately. For the position transformation the WGS 84 coordinates are first transformed using a Classical 3D pre-transformation to obtain preliminary local cartesian coordinates. These are projected onto a preliminary grid using the specified ellipsoid and map projection. Then the 2 shifts, the rotation and the scale factor of a Classical 2D transformation are calculated to transform the preliminary to the ”r;real” local coordinates.

The position transformation requires knowledge of the local map projection and the local ellipsoid. However, as the distortions of the map projection are taken into account, Two Step transformations can be used for larger areas than One Step transformations.

The height transformation is a single dimension height approximation.

As with the Interpolation, Stepwise or One Step approaches, the height and position transformations are separate and, therefore, errors in height do not propagate into errors in position. Additionally, if knowledge of local heights is not good or non-existent you can still create a transformation for position only. Also, the height points and position points do not have to be the same points.

Because of the way in which the transformation works it is possible to compute transformation parameters with just one point in the local and WGS84 system.

The combinations of the number of points in position and the position transformation parameters that can be calculated from them are as follows:

No. of position points	Transformation Parameters Computed
1	Classical 2D with shift in X and Y only
2	Classical 2D with shift in X and Y, Rotation about Z and Scale
more than 2	Classical 2D with shift in X and Y, Rotation about Z, Scale and Residuals

The number of points with height included in the transformation directly affects the type of height transformation produced.

No. of height points	Height transformation based on
0	No height transformation
1	Constant height transformation
2	Average constant between the two height points.
3	Plane through the three height points
more than 3	Average plane

The Advantages:

- Errors in local heights do not affect the position transformation
- The points used for determining the position and height transformation do not necessarily have to be the same points.
- The distortions of the map projection are taken into account which enables you to use this kind of transformation for larger areas.

The Disadvantage:

- Knowledge of the local projection and local ellipsoid are required.

Other transformation approaches:

Classical 3D

Classical 2D

One Step

Interpolation

Stepwise

Which approach to use

Stepwise

Background Information:

The Stepwise transformation approach is effectively a combination of the Classical 3D approach and the Interpolation method. The position and height transformations are split into two separate components. A Classical transformation approach is used for the position transformation and an Interpolation method used for the height.

For this method, we recommend that you have at least four points for which the coordinates are known in the local grid system and in WGS84. It is possible to compute transformation parameters using only three common points but using four allows for residuals to be calculated. In addition you need to know the type of map projection on which the local coordinates are based and it's parameters, as well as the local ellipsoid used.

Because this approach splits the transformation into two separate components, position and height are independent of each other as with the Interpolation method. This means that the points used for determining the position and height transformation do not necessarily have to be the same points.

As the position transformation is determined using the Classical 3D approach, the transformation area may be larger than with the Interpolation Transformation. The limiting factor for the transformation area is the accuracy of the height transformation.

Basically, the method works like this:

1. The center of gravity of the common points is computed.
2. The shifts between WGS84 and the local ellipsoid are computed.
3. The map projection is applied to the WGS84 points.
4. The Classical 2D transformation parameters are determined.
5. The height interpolation is determined.

In flat or relatively flat areas, where good heights are available in the local system, the approach will have no problem in constructing a good height transformation for relatively large areas. The more height points included, the better the height transformation will be.

In areas where it is suspected that the geoid undulation is extreme, the area over which the transformation is carried out should be reduced if accurate heighting is required. Note that position will not be affected by extreme geoid undulations.

The Advantages:

- Errors in local heights do not affect the position transformation
- The points used for determining the position and height transformation do not necessarily have to be the same points.
- The height transformation method will provide accurate height transformations without any knowledge of geoid separations as long as the geoid/ellipsoid separation is reasonably constant and does not contain sudden changes. The more height points included the better the model.

The Disadvantage:

- Knowledge of the local projection and local ellipsoid are required.

Other transformation approaches:

Classical 3D

Classical 2D

One Step

Two Step

Interpolation

Which approach to use

Interpolation

The Interpolation approach creates transformation parameters based on an affine transformation model that uses a Collocation algorithm to estimate the systematic part of the noise.

Basically what this means is that the WGS84 coordinates measured by the GPS are squeezed or stretched to fit the local grid. The local grid is constructed using the entered grid coordinates.

Position and height are treated separately and as such are independent of each other. This means that the measured position points do not necessarily have to be the same points for which height is known and that errors in local height measurement will not be propagated into the position transformation component.

The Interpolation approach has certain advantages over a traditional 3D Classical approach in that parameters can be calculated without knowledge of the map projection or local ellipsoid. Additionally, heights and position are transformed independently of each other. This means that the local coordinates do not have to contain the height information. The height information may be obtained from different points.

The Interpolation approach will tend to distort the GPS measurements to fit the existing local grid measurements. This may be an advantage or disadvantage as the GPS coordinates are generally found to be better than the existing grid coordinates. That is to say that they are more homogenous.

This means that the accuracy of the GPS coordinates may be slightly compromised when using this method. This may be advantageous if you want future transformed GPS points to tie in with your existing local network.

The Advantages:

Errors in local heights do not affect the position transformation

The parameters can be calculated without knowledge of the map projection or local ellipsoid

The points used for determining the position and height transformation do not necessarily have to be the same points.

The Disadvantage:

The main disadvantage of the interpolation approach is that it is restricted in the area over which it can be applied. This is mainly due to the fact that there is no provision for scale factor in the projection. In practical terms, the area over which this transformation approach can be applied is about 10-15km square.

Other transformation approaches:

Classical 3D

Classical 2D

One Step

Two Step

Which approach to use Stepwise

Which approach to use

This question is almost impossible to answer since the approach used will depend totally on local conditions and information.

If you wish to keep the GPS measurements totally homogenous and the information about the local map projection is available, the Classical 3D approach would be the most suitable.

If you are unsure of the local height information but the position information is accurate and you wish to keep the GPS measurements homogenous in position, then the Stepwise approach may be the most suitable.

For cases where there is no information regarding the ellipsoid and/or map projection and/or you wish to force the GPS measurements to tie in with local existing control then the One-Step approach may be the most suitable. Alternatively if a large number of common points are available and a more accurate approximation is required the

Interpolation approach can be used.

The Two-Step approach also treats position and height information separately which allows for position only control points to be used as well. Compared to the One-Step approach, information regarding the ellipsoid and map projection has to be known. The advantage is that this approach can be used for larger areas than the One-Step.

Further Information:

Classical 2D

Classical 3D

One Step

Stepwise

Interpolation

Two Step

Add a New Transformation

A Transformation is usually calculated using the **Leica LGO Datum/Map** tool. However a Classical 2D and Classical 3D may also be added manually:

Follow these steps to add a new Transformation.

Step	Action
1	Right-click on **Transformations** in the Tree-View and select **New**.
2	Enter the **Name** of the transformation.
3	Select the **Type** of the transformation. Note: Only the types Classical 2D and Classical 3D may be added manually. Other transformation types can only be added (determined) using the **Leica LGO Datum/Map** tool.
4	Select the **Height Mode** of the Transformation. Choose between Ellipsoidal or Orthometric. Note: The Height Mode may only be selected for Classical 3D Transformations. It can also be determined using the **Leica LGO Datum/Map** tool.
5	Enter the necessary **parameters** of the selected transformation type.
6	Press **OK** to confirm or **Cancel** to abort the function.

Delete a Transformation

Important Information:

- Transformations that are currently used in a Coordinate Systems are indicated by and cannot be deleted.

Delete a Transformation:

Follow these steps to delete a Coordinate System

Step	Action
1	Right-click on a Transformation in the Tree-View or Report-View and select **Delete**.
2	Press **Yes** to confirm or **No** to exit without deleting.

Transformation Properties

This Property-Sheet enables you to display/edit the Transformation Properties.

Important Information:

- Only the Properties of *Classical 3D*, *Classical 2D*, *One Step-* or *Two Step* Transformations may be displayed.
- For Two Step transformations an additional page Pre-transformation is accessible.

Edit a Transformation:

Follow these steps to edit a Transformation.

Step	Action
1	Right-click on a Transformation in the Report-View or Tree-View and select **Properties**.
2	Make your changes in the page General. Note: Only the fields with white background may be edited at the particular instant.
3	Press OK to confirm or Cancel to abort the function.

Transformation Properties: General

Background Information:

This Property-Page enables you to display/edit the Transformation Properties. In addition to the Properties of a Classical 2D or Classical 3D Transformation those of any One Step or Two Step Transformation may be displayed.

General Settings:

Field	Description
Name	Name of Transformation. The Name can only be changed if the Transformation is not being currently used in any Coordinate System definition.
Type	The Type *Classical 3D,Classical 2D, One Step* or *Two Step* is displayed and cannot be changed.
Height Mode	Displays the height mode of the selected Transformation. The height mode is set in Datum & Map in the Configuration page.
Last modified	Date and Time the Transformation was last modified.
Ellip. A	Restricts the use of the Transformation to convert coordinates of the selected Ellipsoid (Datum) only. For *Classical 3D, One Step* or *Two Step* it is usually set to *WGS1984*. 'Ellip. A' can only be modified if the Transformation is not currently in use in any Coordinate System definition.
Ellip. B	If an Ellipsoid for System B is defined, the Transformation is restricted to be used to convert to the selected Datum only. For *Classical 3D* it is usually set to a local Ellipsoid. Since *One Step* Transformations typically work without knowledge of a local ellipsoid 'Ellip.B' is usually set to *None* in this case.
Projection	Restricts the use of a *Classical 2D* Transformation to a particular Projection. When editing the properties of a *One Step* Transformation the projection edit field is not shown at all, since *One Step* Transformations are based upon their own kind of projection. They are not related to a classical map projection. In case of a *Two Step* transformation the projection used is pre-defined as the projection attached to the System B Project in Datum & Map.
Model	With the *Classical 3D* Transformation you are allowed for the choice of two different transformation models: Bursa-Wolf or Molodensky-Badekas.
dx, dy, dz	Translations in X, Y and Z direction. For a *Classical 2D*, a *One Step* or a *Two Step* Transformation dx and dy correspond to translations in local Easting and Northing.

Rx, Ry, Rz	Rotations around the X, Y and Z axis. For a *Classical 2D* Transformation as well as for the *One Step* and *Two Step* Transformation only Rz is available. With plane grid coordinates this is the axis being perpendicular to the plane. Any rotation of such a plane system is about the Z axis.
SF	Scale factor in ppm (e.g. mm/km)

Transformation Properties: Pre-transformation

Background Information:

This page is only available for Two Step transformations and enables you to display the properties of the Pre-transformation used in the calculation of Two Step transformations. The parameters are not editable.

Pre-transformation Settings:

Field	Description
Name	Name of Pre-transformation.
Type	The Type is fixed to *Classical 3D*. Only *Classical 3D* transformations are allowed to be used as Pre-transformations.
Last modified	Date and Time the Transformation was last modified.
Ellip. A, Ellip.B	Displays the ellipsoid A and ellipsoid B properties of the selected Pre-transformation. Note: When applying a Two Step transformation in a coordinate system always the ellipsoid associated with that coordinate system is used for the calculation even if this collides with ellipsoid B of the Pre-transformation. The ellipsoid B of the Pre-transformation will be ignored then.
Model	As with all *Classical 3D* Transformations the Pre-transformation can also be one of two different transformation models: Bursa-Wolf or Molodensky-Badekas.
dx, dy, dz	Translations in X, Y and Z direction.
Rx, Ry, Rz	Rotations around the X, Y and Z axis.
SF	Scale factor in ppm (e.g. mm/km)

Ellipsoid

Ellipsoids: Overview

This component enables you to manage the Reference Ellipsoids. An Ellipsoid is defined by the semi-major axis (a) and the flattening (f). The flattening is related to the semi-minor axis (b) by:

$f = (a-b) / a$

In LGO an ellipsoid is defined by the name, the semi-major axis (a) and the reciprocal value of flattening (1/f).

Most of the ellipsoids in use around the world are already defined in LGO:

Name	(a)	(1/f)
Airy	6377563.396	299.32496460000
Airy (Modified)	6377340.189	299.32496460000
ATS-77	6378135.000	298.25700000000
Australian National	6378160.000	298.25000000000
Bessel 1841	6377397.155	299.15281285000
Clarke 1866	6378206.400	294.97869820000
Clarke 1880	6378249.145	293.46500000000
Everest	6377276.345	300.80170000000
Fisher 1960 (South Asia)	6378155.000	298.30000000000
Fisher 1960 (Mercury)	6378166.000	298.30000000000
Fisher 1968	6378150.000	298.30000000000
GRS 1967	6378160.000	298.24716743000
GRS 1980	6378137.000	298.25722210088

	Hough 1956	6378270.000	297.00000000000
	Int. Hayford	6378388.000	297.00000000000
	Krassowski	6378245.000	298.30000000000
	South American 1969	6378160.000	298.25000000000
	WGS72	6378135.000	298.26000000000
	WGS84	6378137.000	298.25722356300
	Xi'an-80	6378140.000	298.25700000000

Note:

- The Ellipsoids indicated by are hardwired and can neither be deleted nor edited.
- User defined Ellipsoids, which are currently being used in a Coordinate System, are indicated by and may not be deleted or renamed, but the parameters may be edited.

Select from the index below to learn how to manage the Ellipsoids:

Add a New Ellipsoid

Delete an Ellipsoid

Ellipsoid Properties

Add a New Ellipsoid

Follow these steps to add a new Ellipsoid.

Step	Action
1	Right-click on Ellipsoids in the Tree-View and select **New.**
2	Enter the **Name** of the Ellipsoid.
3	Enter the **Semi-major axis (a)** of the Ellipsoid.
4	Enter the **Reciprocal flattening (1/f)** of the Ellipsoid.
5	Press **OK** to confirm or **Cancel** to abort the function.

Delete an Ellipsoid

Important Information:

- The Ellipsoids indicated by are hardwired and cannot be deleted.
- User defined Ellipsoids, which are currently being used in a Coordinate System, are indicated by and may not be deleted.

Delete an Ellipsoid:

Follow these steps to delete an Ellipsoid.

Step	Action
1	Right-click on an Ellipsoid in the Tree-View or Report-View and select **Delete**.
2	Press **Yes** to confirm or **No** to exit without deleting.

Ellipsoid Properties

This Property-Sheet enables you to display/edit the Ellipsoid Properties.

Important Information:

- The Ellipsoids indicated by ⊗ are hardwired and cannot be modified.

Edit an Ellipsoid:

Follow these steps to edit an Ellipsoid.

Step	Action
1	Right-click on a Ellipsoid in the Explorer-View or Tree-View and select **Properties**.
2	Make your changes in the page General. Only the fields with white background may be edited at the particular instant.
3	Press **OK** to confirm or **Cancel** to abort the function.

Ellipsoid Properties: General

Background Information:

This Property-Page enables you to display/edit the Ellipsoid Properties.

General Settings:

Field	Description
Name	Name of Ellipsoid. The Name can only be changed if the Ellipsoid is not hardwired or not used in any Coordinate System definition.
Semi-major axis (a)	Displays the value for the semi-major axis.
Reciprocal flattening (1/f)	Displays the reciprocal value of the flattening.
Last modified	Date and Time the Ellipsoid was last modified.

Projections

Projections: Overview

For each different mapping area the user may define a Projection. A Projection allows the conversion of *Geodetic* coordinates to *Grid* coordinates or vice versa.

Most of the Projections can be defined using one of the methods below. Alternatively you may define your own User defined Projection in the form of a user written program or you may use one of the Customized Projections (see below).

The Projection types that can be user defined are:

- Mercator
- Transverse Mercator (TM)
- Oblique Mercator
- Universal Transverse Mercator (UTM)
- Cassini - Soldner
- Lambert - one Standard Parallel
- Lambert - two Standard Parallels
- Polar Stereographic
- Double Stereographic
- Rectified Skewed Orthomorphic
- User defined

Certain map Projections that are not definable using one of the methods above, have been hardwired in LGO and can neither be deleted nor changed. These Projections are called **Customized** Projections and they have pre-defined Ellipsoids. The relationship between these Projections and the Ellipsoids are fixed as follows:

Projection	Ellipsoid
Czech and Slovak	Bessel
DK (S34) Bornholm	International (Hayford)
DK (S34) Jylland	International (Hayford)
DK (S34) Sjelland	International (Hayford)

	Dutch	Bessel
	Finnish KKJ	International (Hayford)
	Hungarian	GRS 1967
	Malayan	Everest
	New Zealand	International (Hayford)
	Romania Stereo 70	Krassowski
	Swiss	Bessel
	Swiss95	Bessel

Note:

- Defining a Coordinate System the user has the choice between Projections and State Plane Zones.
- A Projection is not required if you are using a One Step or an Interpolation Transformation.
- The Projections indicated by are hardwired and can neither be deleted nor edited.
- The Projections, which are currently being used in a Coordinate System, are indicated by and cannot be deleted or renamed, but the parameters may be edited.

Select from the index below to learn how to manage the Projections:

Add a New Projection

Delete a Projection

Projection Properties

Add a New Projection

Follow these steps to add a new Projection.

Step	Action
1	Right-click on Projections in the Tree-View and select **New**.
2	Enter Name of Projection. It is often useful to give any Projection set a meaningful name that identifies the area in which the Projection is applicable. For example: UTM, Zone 5, hemisphere north (UTM 5 North).
3	Select **Type** of Projection: Mercator Transverse Mercator (TM) Oblique Mercator Universal Transverse Mercator (UTM) Cassini - Soldner Lambert - one Standard Parallel Lambert - two Standard Parallels Polar Stereographic Double Stereographic Rectified Skewed Orthomorphic or User defined
4	Enter the necessary parameters of the selected Projection.
5	Choose **OK** to accept entered values or **Cancel** to abort the function.

Delete a Projection

Important Information:

- The Projections indicated by are hardwired and can neither be deleted nor edited.
- The Projections, which are currently being used in a Coordinate System, are indicated by and cannot be deleted.

Delete a Projection:

Follow these steps to delete a Projection.

Step	Action
1	Right-click on a Projection in the Tree-View or Report-View and select **Delete.**
2	Press **Yes** to confirm or **No** to exit without deleting.

Projection Properties

Background Information:

This Property-Sheet enables you to display/edit the Projection Properties.

Important Information:

- The Projections indicated by are hardwired and cannot be modified.
- The Projections, which are currently being used in a Coordinate System, are indicated by and cannot be renamed, but the parameters may be edited.

Edit a Projection:

Follow these steps to edit a Projection.

Step	Action
1	Right-click on a Projection in the Explorer-View or Tree-View and select **Properties**.
2	Make your changes. The parameters may vary depending on the type of Projection that is selected: Mercator Transverse Mercator (TM) Oblique Mercator Universal Transverse Mercator (UTM) Cassini - Soldner Lambert - one Standard Parallel Lambert - two Standard Parallel Polar Stereographic Double Stereographic Rectified Skewed Orthomorphic User defined
3	Press **OK** to confirm or **Cancel** to abort the function.

Mercator

Conformal Projection onto a cylinder with its axis lying on a meridian plane. The cylinder is tangent to the sphere (ellipsoid) along the equator.

The Projection is defined by:

- False Northing and False Easting
- Central Meridian

Transverse Mercator (TM)

Conformal Projection on to a cylinder with its axis lying on the equatorial plane. The cylinder is tangential to a meridian. The Projection is defined by:

- False Easting and False Northing
- Latitude of Origin
- Central Meridian
- Scale Factor at Origin (Central Meridian)

A zone width can also be defined. Points that exceed the zone width by 1° are not converted.

For a scale factor = 1 the cylinder is tangent to the sphere (ellipsoid), for a scale factor < 1 it is secant. Secant means the cylinder intersects the sphere along two straight lines equidistant from the central meridian. In this case the scale is true (1) along these two straight lines.

Oblique Mercator

Conformal Projection on to a cylinder. The cylinder is tangent to any circle other than the equator or a meridian. The Projection is defined by:

- False Easting and False Northing
- Latitude of Origin
- Central Meridian
- Angle (Type: Azimuth or Skew)
- Scale Factor at Origin

For a scale factor = 1 the cylinder is tangent to the sphere, for a scale factor < 1 it is secant. Secant means the cylinder intersects the sphere along two straight lines equidistant from the central meridian. In this case the scale is true along these two straight lines.

Universal Transverse Mercator (UTM)

Transverse Mercator Projection with fixed zone-defining constants. Thus it is sufficient to define:

- Zone Number (1-60)
- Hemisphere (north or south)

Zone-defining constants:

- Origin: Intersection of equator and central meridian of each zone
- Scale factor at central meridian: 0.9996
- Zone width: 6° (3° east and 3° west of the central meridian)
- Zone numbering: starting with number 1 for zone 180° west to 174° west and increasing eastwards
- False Northing: 0 for northern hemisphere, 10'000'000 m for southern hemisphere
- False Easting: 500'000 m

Note:

- The Central Meridian is selected automatically according to the selected Zone Number.
- Points, which exceed the zone width by 1° are not converted. (4° east and 4° west of the central meridian)

Cassini - Soldner

Projection on to a Cylinder. It is neither equal area nor conformal. The scale is true along the central meridian and along lines perpendicular to central meridian.

The Projection is defined by:

- False Easting and False Northing
- Latitude of Origin
- Central Meridian

Lambert - one Standard Parallel

Conformal Projection on to a cone, with its axis coinciding with the z-axis of the ellipsoid, defined by:

- False Easting and False Northing
- Latitude of Origin
- Central Meridian
- Standard Parallel
- Scale Factor at Origin

If the Scale Factor at Origin = 1 the cone is tangent to the sphere (ellipsoid), if it is < 1 it is secant. Secant means the cone intersects the sphere along two parallel lines. In this case the scale is true along these two parallel lines.

Lambert - two Standard Parallels

Conformal Projection on to a cone, with its axis coinciding with the z-axis of the ellipsoid. The cone is secant to the sphere. The Projection is defined by:

- False Easting and False Northing
- Latitude of Origin
- Central Meridian
- First Standard Parallel
- Second Standard Parallel

Polar Stereographic

Conformal azimuthal Projection on to a plane. The point of Projection is on the surface of the sphere (ellipsoid) diametrically opposite of the origin (centre of the Projection). The Projection is defined by:

- False Easting and False Northing
- Latitude of Origin
- Central Meridian
- Scale Factor at Origin

If the Scale Factor at Origin = 1 the plane is tangent to the sphere (ellipsoid), if it is < 1 it is secant. Secant means the plane intersects the sphere along a circle. In this case the scale is true along this circle.

Double Stereographic

Conformal azimuthal Projection on to a plane. The point of Projection is on the surface of the sphere diametrically opposite of the origin (centre of the Projection).

The Projection is defined by:

- False Easting and False Northing
- Latitude of Origin
- Central Meridian
- Scale Factor at Origin

If the Scale Factor at Origin = 1 the plane is tangent to the sphere, if it is < 1 it is secant. Secant means the plane intersects the sphere along a circle. In this case the scale is true along this circle.

Rectified Skewed Orthomorphic

This is a special type of **Oblique Mercator** Projection, defined by:

- False Easting and False Northing
- Latitude of Origin
- Central Meridian
- Angle Type (Azimuth or Skew)
- Rectify Type (Azimuth or Skew)
- Scale Factor at Origin

For a scale factor = 1 the cylinder is tangent to the sphere (ellipsoid), for a scale factor < 1 it is secant.

User defined projections

For Projections, which cannot be defined by the implemented standard Projections, the user can write his own program for a particular Projection.

The necessary input for the program has to be read from an ASCII file, the produced output has to be written to an ASCII file.

A Projection set accessing this user program can then be created by specifying the program's name and path:

Field	Description
Name	Name of the user defined Projection.
Path of EXE file	Path and file name (including the extension .EXE). To select from the browser click ....

Requirements for the user program:

- It must be an executable program.
- No interaction is allowed.
- Input and output for the user program has to be organised according to a specified File Format .

Related topics:

Input / Output file format for User defined Map Projection

Example of a User-written Program

File Format of INPUT.USR and OUTPUT.USR

Whenever LGO converts Grid coordinates to Geodetic coordinates or vice versa, intermediate files are created internally which are passed to the applied Projection program. In the case of a User-defined program, the programmer has to know the format of these intermediate files.

Input.usr

This is the file, which has to be accessed to read in the coordinates to be converted into the user defined map Projection program.

Line 1

- Flag for identification of coordinate type:
- 1 = geodetic coordinates
- 2 = grid coordinates

Line 2

- Semi-major axis of reference ellipsoid.

Line 3

- Flattening of reference ellipsoid.

Following lines

Each line contains:

- in case of geodetic coordinates: latitude and longitude (in radians) for one point.
- in case of grid coordinates: easting and northing for one point.

Example of INPUT.USR file for geodetic coordinates:

```
1

6378137.000

0.003352810665

0.826317296827 0.167522411309

0.826317295438 0.167522411668

0.826317295735 0.167522412147

0.826317296574 0.167522411113

0.826317295208 0.167522411696

0.826317294691 0.167522410838

0.826317293977 0.167522410262

0.826317295626 0.167522410202

0.826317295911 0.167522411033

0.826317295738 0.167522410997
```

Example of INPUT.USR file for grid coordinates:

```
2

6378137.000

0.003352810665

763092.409 245766.864

763092.411 245766.855

763092.413 245766.857
```

```
763092.408 245766.862

763092.411 245766.854

763092.407 245766.850

763092.405 245766.845

763092.405 245766.856

763092.408 245766.858

763092.408 245766.857
```

Output.usr

This is the file into which the result of the Projection conversion, (i.e. the converted coordinates) has to be written.

All lines

Each line contains:

- in case of grid coordinates output: easting and northing for one point.
- in case of geodetic coordinates output: latitude and longitude (in radians) for one point.

Example of OUTPUT.USR file for grid coordinates:

```
763092.409 245766.864

763092.411 245766.855

763092.413 245766.857

763092.408 245766.862

763092.411 245766.854

763092.407 245766.850

763092.405 245766.845
```

```
763092.405 245766.856

763092.408 245766.858

763092.408 245766.857
```

Example of OUTPUT.USR file for geodetic coordinates:

```
0.826317296864 0.167522411279

0.826317295443 0.167522411684

0.826317295748 0.167522412158

0.826317296554 0.167522411036

0.826317295286 0.167522411677

0.826317294676 0.167522410728

0.826317293899 0.167522410235

0.826317295626 0.167522410305

0.826317295927 0.167522411010

0.826317295770 0.167522411004
```

Example of a User-written Program

The following example shows a User–written Program (written in Turbo Pascal) for the Swiss Projection. It transforms Swiss Grid coordinates to Geodetic coordinates (and vice versa). This map Projection is already included as a customized Projection.

The line numbers at the beginning of each line are for reference only. They do not constitute part of the source code.

```
001 Program CH_Projection_Set;
002
003 const
004 pi= 3.1415926535;
005 eps= 1.0e-10; {convergence limit}
006
007 {constants for Bessel ellipsoid}
008 ae= 6377397.155; {semi major axis}
009 ex2= 0.006674372231; {e squared}
010 lato= 46.952405556; {ell. latitude of Bern}
011 lono= 7.439583333*pi/180; {ell. longitude of Bern}
012
013 {derived constants for sphere}
014 r = 6378815.9036; {radius}
015 alpha = 1.00072913847; {scale factor along meridian through Bern}
017 rk = 0.00306673233; {integration constant}
018 bo= 46.907731456*pi/180; {spherical latitude of Bern}
019
020 var dumy: extended;
021 y,x,h,y1,x1: extended;
022 lquer,bquer,wert,wert1,wert2,bk,lk: extended;
023 cobo,sibo,cobi,sibi,coli,sili: extended;
024 ex,lati,loni,ritko: extended;
025 id: integer;
026 a,b: text;
027
```

```
{********* Main Program *********}
begin
{Assign and open files}
assign(a,'input.usr');
reset(a);
assign(b,'output.usr');
rewrite(b);
{Read the first 3 lines}
readln(a,id); {read type}
readln(a,dumy); {read semi-major axis, (not used, fixed programmed)}
readln(a,dumy); {read flattening, (not used,fixed programmed)}
if id = 1 then begin
{Transformation ELLIPSOID to GRID coordinates}
while not EOF(a) do begin
readln(a,lati,loni);
{transformation ellipsoid to sphere}
ex:= sqrt(ex2);
wert1:= pi/4.0+lati/2.0;
wert1:= alpha*ln(sin(wert1)/cos(wert1));
wert2:= ln((1.0+ex*sin(lati))/(1.0-ex*sin(lati)));
wert:= exp(wert1-(alpha*ex/2.0*wert2)+rk);
bk:= 2.0*(arctan(wert)-pi/4.0);
lk:= alpha*(loni-lono);
{transformation sphere to sphere}
cobo:= cos(bo);
```

```
sibo:= sin(bo);
cobi:= cos(bk);
sibi:= sin(bk);
coli:= cos(lk);
sili:= sin(lk);
wert1:= cobo*sibi-sibo*cobi*coli;
bquer:= arctan(wert1/(sqrt(1.0-wert1*wert1)));
lquer:= arctan(cobi*sili/(sibo*sibi+cobo*cobi*coli));
{transformation sphere to plane}
x1:= r/2.0*ln((1.0+sin(bquer))/(1.0-sin(bquer)));
y1:= r*lquer;
{transformation civil to military coordinates}
x:= x1+200000.0;
y:= y1+600000.0;
{output}
writeln(b,y:15:4,x:15:4);
end;
end;
if id = 2 then begin
{Transformation GRID to ELLIPSOID}
while not EOF(a) do begin
readln(a,y,x);
{transformation military to civil coordinates}
y1:= y-600000.0;
x1:= x-200000.0;
{transformation plane to sphere}
lquer:= y1/r;
bquer:= 2.0*(arctan(exp(x1/r))-pi/4.0);
```

```
{transformation sphere to sphere}
cobo:= cos(bo);
sibo:= sin(bo);
cobi:= cos(bquer);
sibi:= sin(bquer);
coli:= cos(lquer);
sili:= sin(lquer);
wert:= cobo*sibi+sibo*cobi*coli;
bk:= arctan(wert/(sqrt(1.0-wert*wert)));
lk:= arctan(cobi*sili/(cobo*cobi*coli-sibo*sibi));
{transformation sphere to ellipsoid}
ex:= sqrt(ex2);
lati:= bk;
repeat
ritko:= lati;
wert1:= pi/4.0+bk/2.0;
wert1:= sin(wert1)/cos(wert1);
wert1:= ln(wert1)/alpha;
wert2:= ln((1.0+ex*sin(lati))/(1.0-ex*sin(lati)))*ex/2.0;
lati:= 2.0*(arctan(exp(wert1+wert2-rk/alpha))-pi/4.0);
until (abs(ritko-lati)<eps);
loni:=lono+lk/alpha;
{output}
writeln(b,lati:15:12,loni:15:12);
end;
end;
close(a);
close(b);
end.
```

There are a few minor constraints in the user written program that must be observed in order to be able to integrate it into a user–defined Projection set:

Line	Description
034	The file name for the file containing the coordinates that are to be transformed (for grid coordinates as well as for geodetic coordinates) has to be INPUT.USR
036	The name of the file to output the transformed coordinates (for Grid coordinates as well as for Geodetic coordinates) has to be OUTPUT.USR
041	The first line of the INPUT.USR file containing the information flag for the type of coordinates is read in: 1 = geodetic coordinates. 2 = grid coordinates.
042	The second line of the INPUT.USR file containing the value for the semi–major axis of the reference ellipsoid is read in. In this example the value is not used because it is implicitly stated in the program parameters.
043	The third line of the INPUT.USR file containing the value for the flattening of the reference ellipsoid is read in. In this example the value is not used because it is implicitly stated in the program parameters.
046	The switch is set to transform from Geodetic to Grid coordinates.
051	The rest of the lines of the INPUT.USR file containing, in this case, Geodetic coordinates (latitude and longitude, in radians) are read in.
082	The resultant Grid coordinates are written to the OUTPUT.USR file. First Easting then Northing.
086	The switch is set to transform from Grid to Geodetic coordinates.
091	The rest of the lines of the INPUT.USR file containing, in this case, Grid coordinates (Easting and Northing) are read in.
126	The resultant Geodetic coordinates are written to the OUTPUT.USR file, first latitude then longitude (in radians).

State Plane Zones

State Plane Zones: Overview

The State Plane Zones are special predefined Projection zones used for the State Plane Coordinate System (SPCS) in North America. They are hardwired in LGO and can neither be modified nor deleted.

State Plane Zones are available only if **North-America** has been selected in *Coordinate System Definitions* during the installation of LGO.

Depending on the shape of a state, the zones have predefined Projection types and parameters associated with them.

The following Projection types are used for the State Plane Zones:

Transverse Mercator (TM)

Oblique Mercator

Lambert - one Standard Parallel

Lambert - two Standard Parallels

Tip:

If you define a Coordinate System you may either use the configurable Projections or the State Plane Zones. See also How to switch between Projections and State Plane Zones.

Related Topics:

Properties of State Plane Zones

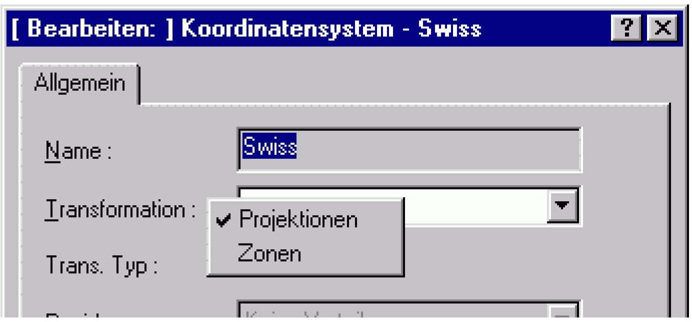
State Plane Zone Properties

The State Plane Zone Properties are similar to the Projection Properties. Since the State Plane Zones are pre-defined Projections none of the parameters may be edited.

How to switch between Projections and State Plane Zones

This function enables you to switch between selecting Map Projections or US State Plane Zones in the Coordinate Systems Property-Page.

- Right-click on the background of the Property-Page of a Coordinate System and select between **Projections** and **Zones**.



Geoid Models

Geoid Models: Overview

The user can utilise a Geoid Model that is appropriate for the mapping area under consideration. An Ellipsoid is attached to the Geoid Model. It is the user's responsibility to obtain the model, which will be in the form of an executable computer program. Geoid Models can be defined for Geodetic or Grid Coordinates and refer to a particular Ellipsoid.

With a Geoid Model attached to a Coordinate System you can Compute Geoid Separations of the Points in a Project. The Geoid Model replaces the requirement for you to manually input Geoid Separations for your points.

If Geoid Separations are available it enables you to switch between viewing *Ellipsoidal* and *Orthometric* heights. The relationship between *Ellipsoid* and *Orthometric* heights is given by:

Ellipsoidal Height (h) = Orthometric Height (H) + Geoid Separation (N)

Geoid Models may also be used on the receiver in the field. To do so you have to Create a Geoid Model field file and then upload the file to the receiver using the Data Exchange Manager.

Note:

- Geoid Models are always an approximation of the actual Geoid. In terms of accuracy, they may vary considerably and in particular global models should be used with care. If the accuracy of the Geoid Model is not known it might be safer to use local control points with orthometric heights and apply a transformation to approximate the local geoid. The Classical 3D Transformation can be used in areas where the geoid has a regular shape, while the Stepwise Transformation is particularly suitable if the local geoid contains large variations within the mapping area.
- Geoid Models that are currently used in a Coordinate System are indicated by ⚠ and cannot be deleted.

Select from the index below to learn how to manage the Geoid Models:

Add a New Geoid Model

Delete a Geoid Model

Geoid Model Properties

Related Topics:

[How to write your own Geoid Model]

[Compute Geoid Separations]

[Create Geoid Model field file]

Add a New Geoid Model

Follows these steps to add a new Geoid Model.

Step	Action
1	Right-click on Geoids in the Tree-View and select **New**.
2	Enter the **Name** for the new Geoid Model.
3	Select the **Coordinate Type** (*Geodetic* or *Grid*) the Geoid Model shall be defined for. (For coordinate type *Geodetic with height scaling* see: Geoid models with height scaling).
4	Select the reference **Ellipsoid** which the model shall refer to. Note: For the Geodetic geoid models which refer to the WGS84 ellipsoid you may select ☑ **Apply on the local side**. The geoid separations will then be applied after the transformation, i.e. to the local ellipsoidal heights.
5	Enter the **path** and name of the user-written executable file (i.e. the program name) or press ... to select from the browser.
6	Enter an optional **Note** to describe the Geoid Model.
7	Press **OK** to confirm or **Cancel** to abort the function.

Delete a Geoid Model

Important Information:

- Geoid Models that are currently used in a Coordinate System are indicated by and cannot be deleted.

Delete a Geoid Model:

Follow these steps to delete a Geoid Model.

Step	Action
1	Right-click on a Geoid Model in the Tree-View or Report-View and select **Delete.**
2	Press **Yes** to confirm or **No** to exit without deleting.

Geoid Model Properties

Background Information:

This Property-Sheet enables you to display/edit the Geoid Model Properties.

Important Information:

- Geoid Models that are currently used in a Coordinate System are indicated by and cannot be renamed but only modified.

Edit a Geoid Model:

Follow these steps to edit a Geoid Model.

Step	Action
1	Right-click on a Geoid Model in the Report-View or Tree-View and select **Properties**.
2	Make your changes in the page General. Note: Only the fields with white background may be edited at the particular instant.
3	If the Geoid model is defined from a *.gem* file, view the extents and spacing of the model in the Extents page.
4	Press **OK** to confirm or **Cancel** to abort the function.

Geoid Model Properties: General

Background Information:

This Property-Page enables you to display/edit the Geoid Model Properties.

- Geoid models can either be defined by an executable file or by a geoid model field file. For geoid models being defined by a field file the geoid separations required in your project are always kept up to date, whereas for geoid models being defined by an executable file it is necessary to manually compute geoid separations.
- Geoid Models that are currently used in a Coordinate System are indicated by ⚠ and cannot be renamed but only modified.

General Settings:

Field	Description
Name	Name of Geoid Model. The Name can only be changed if the Geoid Model is not used in any Coordinate System definition.
Coordinate Type	A Geoid Model may calculate Geoid separation values for either *Geodetic* or *Grid* Coordinates. Ask the provider of the Model for the required Coordinate Type. (For coordinate type *Geodetic with height scaling* see: Geoid models with height scaling).
Ellipsoid	A Geoid Model is referenced to a particular Ellipsoid. Ask the provider of the Model for the correct Ellipsoid.
Apply on the local side	For the Geodetic geoid models which refer to the WGS84 ellipsoid you may select ☑ **Apply on the local side**. The geoid separations will then be applied after the transformation, i.e. to the local ellipsoidal heights.
Path of EXE file:	Path and file name (including the extension .EXE). To select from the browser click ... .
Note	Displays the optional Note to describe the Geoid Model. The Note may be up to 64 characters long.
Last Modified	Displays the Date and Time the Geoid Model was last modified.

Geoid Model Properties: Extents

This page enables you to display the extents of the Geoid Model.

Field	Description
South-west corner	The coordinates of the lower left (South-west) corner of the model are displayed as local grid coordinates or geodetic coordinates depending on the Coordinate Type of the Geoid model.
North-east corner	The coordinates of the upper right (North-east) corner of the model are displayed as local grid coordinates or geodetic coordinates depending on the Coordinate Type of the Geoid model.
Spacing	The spacing of the grid is displayed according to the Coordinate Type.

How to write your own Geoid Model

The Geoid Model's purpose is to provide Geoid Separations (in meters) that are spatially referenced either in terms of Grid or Geodetic coordinates.

When developing such a model there will be a data file of Geoid Separations that are ordered either on a regularly spaced grid or in some other way (i.e., in an irregular pattern). A computer program can then be written that will read from the database, perform some kind of spatial interpolation, and thus estimate the Geoid Separation at any specific point within the area covered by the model.

In LGO the requirement is for the Geoid Model to output "Interpolated Geoid Separations" that coincide with the locations of points that exist in the Local Grid (or Geodetic) coordinate systems.

It is the user's responsibility to either write, or obtain, a program that will serve as the Geoid Model. Certain guidelines must be followed — they are somewhat similar in nature to those that apply for User defined Projections.

Requirements for the user–defined Geoid Model:

- It must be an executable program.
- No interaction is allowed.
- Input for the user program has to be organised according to the specified file format given below.
- Input, output and external data files have to be accessed from the current directory.

Input into the Geoid Model

When a user–written geoidal model is "called" by LGO, LGO will automatically prepare a file called "INPUT.USR". This file contains all the points for which the executable program has to interpolate the geoidal undulation values. The format of such a file is shown below:

For Geodetic coordinates (Latitude, Longitude) in radians:

0.826317296827 0.167522411309

0.826317295438 0.167522411668

etc.

For Grid coordinates (Easting, Northing) in meters:

763092.4093 245766.8641

763092.4112 245766.8552

etc.

The Geoid Model must read in the coordinate file and then perform its interpolation and preparation of the Geoid Separation values for each point contained in the "INPUT.USR" file.

Note:
In this case the order Easting/ Northing will not be affected by switching the coordinate order under Tools – Options . This has to be taken into account when designing the executable program.

Output from the Geoid Model

The Geoid Model must then write its values to a file called "OUTPUT.USR." This file is a free–format file that contains no header information. The only additional requirement regarding the format of this file is that the Geoid Separations (in meters) must be written in the first column of the file. For Geoid Models of Coordinate Type Geodetic or Grid any additional information

(i.e., column 2, column 3 etc.), which is written to the file, will be ignored by LGO. Each column must be separated by at least one blank space.

Geoid Models of Coordinate Type Geodetic with height scaling can be used to correct the geoid separations with a height dependent scale factor. In this case the output file must contain two columns in each line, which are separated by at least one blank space. The first value is interpreted as the separation and the second value as a scale factor correction.

Note:
If a geoid separation bigger than 500 meters is written to the OUTPUT.USR file, the geoid separation will not be displayed in your project. Such values can be used to mark areas, where the geoid model is invalid.

Compute Geoid Separations

This command enables you to compute Geoid Separations for the points in a Project if a Geoid Model is defined in the Coordinate System used. It replaces the requirement for you to manually input Geoid Separations for your points.

This command is only required if your geoid model is defined by an executable file. If your geoid model is defined by a geoid model field file then the geoid separations of your project are always calculated automatically.

1. Make sure a Geoid Model is defined in the Coordinate System attached to your Project.
2. Open the Project for which you want to compute Geoid Separations.
3. From the Tools menu select Compute Geoid Separations. A Geoid Separation will be calculated and stored for each Point.

Note:

- If the Geoid Model you are using is defined for local Grid coordinates, make sure a Coordinate System with the appropriate Map Projection is attached to your Project.
- If you are using a regional Geoid Model that is defined for a certain area only, make sure the points of the Project are located within this area.
- In View/Edit it is also possible to display contour lines of the geoid for the extents of your project. Please refer to Graphical Settings: View.

Related Topic:

Geoid Model

Create Geoid Model field file

Geoid Models may also be used on the receiver in the field. This command enables you to create a Geoid Model field file.

Geoid models usually consist of a geoid height grid where a Geoid Separation is defined for each grid point. Depending on the extent and the grid spacing of the Geoid Model it may require considerable disk space. In order to use the Geoid Model on a GPS sensor the disk space has to be reduced and a special field file has to be created which will allow the field system to interpolate Geoid Separations.

This command enables you to extract a Geoid height grid from an existing Geoid Model for a particular area. The area boundary can be defined by a rectangle or circle and a grid spacing in meters can be selected. The file can then be uploaded to the receiver using the Data Exchange Manager.

Step	Action
1	From the **Tools** menu select **Create Geoid Model field file...**.
2	Select a Geoid Model from the list or click on **View** and Add a New Geoid Model.
3	Select the method to define the limits of the Geoid Model field file. Select between **Centre & radius** and **Extents**.
4	Enter the Coordinates of the **Center point**, the **Radius** and the Grid **Spacing** or enter the Coordinates of the **South-west** and **North-east** corner and the Grid **Spacing**.
5	Check the **File size**. If you wish to use the file on the System RAM it must not exceed a certain size. Note: The maximum possible file size may vary depending on the free memory in the receivers system RAM. Refer to the Technical Reference Manual on how to free system RAM of the receiver.
6	Click on **Save**.
7	From the browser select the path where the file shall be created.
8	Enter a **File name** without extension (Extension "gem" will be added

	automatically).
9	Click on **Save** to confirm. Note: Depending on the file size, this may take a while.

Related Topic:

Geoid Model: Overview

Geoid models with height scaling

Geoid models of coordinate type Geodetic with height scaling may be used to additionally correct the geoid separations with a scale factor. The scale factor is applied to the height above the ellipsoid on which the model is based.

For such Coordinate Types LGO expects two values -the geoid separation and the height scale factor- to be written to the output file of the geoid model executable. (see also: How to write your own Geoidal Model). This option supports the DFHBF geoid model available in Germany. For details on that model see also http://www.dfhbf.de.

CSCS Models

CSCS Models: Overview

Several countries have produced tables of conversion factors to directly convert between GPS measured coordinates given in WGS84 and the corresponding local mapping coordinates, taking the distortions of the mapping system into account. Using these tables it is possible to directly convert into the local grid system without having to calculate your own transformation parameters. **Country Specific Coordinate System Models** (**CSCS Models**) are an addition to an already defined coordinate system, which interpolates corrections in a grid file and applies the interpolated corrections. The extra step of applying these corrections can be made at different positions in the coordinate conversion process. Therefore different methods of CSCS Models are supported.

Conversion Methods

- **Grid conversion method**: When selecting a CSCS Model of method **Grid**, then -when converting from WGS84 to Local Grid- first the transformation, map projection and ellipsoid specified will be applied to get preliminary grid coordinates. As an extra step a shift in Easting and Northing will be interpolated in the grid file of the CSCS Model resulting in the final local Easting and Northing.
- **Cartesian conversion method**: When selecting a CSCS Model of method **Cartesian**, then -when converting from WGS84 to Local Grid- after the specified transformation a 3D-shift will be interpolated in the grid file of the CSCS Model resulting in Local Cartesian coordinates upon which the specified local ellipsoid and map projection will be applied to get final local Easting and Northing.
- **Geodetic conversion methods** are also possible. When selecting a CSCS Model of method **Geodetic**, then -when converting from WGS84 to Local Grid- a shift in geodetic latitude and longitude will be interpolated in the grid file of the CSCS Model resulting in final local geodetic coordinates to which the map projection is applied.

CSCS Models may also be used on the receiver in the field. To do so you have to Create a CSCS Model field file and then upload the file using the Data Exchange Manager.

Certain CSCS Models are pre-defined and hardwired in LGO. They are already connected to the corresponding grid file. These CSCS Models are:

OSTN02™ (Great Britain)

OSTN97™ (Great Britain)

GR3DF97A (France)

ETRS89-RD (Netherlands)

Danish CSCS Models

SWEREF99RT90 (Sweden)

NZGD49-2000 (New Zealand)

NADCON (U.S.A.)

Models for which the correction files have to be purchased are also supported. It may be necessary to convert the files to LGO's binary CSC file format. For more information see: Other CSCS Models.

Note:

- CSCS Models that are currently used in a Coordinate system are indicated by and cannot be deleted.
- If coordinates which fall outside the area covered by the CSCS model are to be converted then the CSCS model is ignored.

Related topics:

CSCS Model Properties

Create CSCS Model field file

Add a new CSCS Model

Follow these steps to add a new CSCS Model.

Step	Action
1	Right-click on CSCS Models in the Tree-View and select **New**.
2	Enter the **Name** of the CSCS Model.
3	Enter path and name of the grid file or press ... to select from the browser. The *Method*, *Interpolation method* and the *Coordinate type* will be displayed if a valid CSCS file has been selected.
4	Enter the optional **Note** to describe the CSCS Model.
5	Press **OK** to confirm or **Cancel** to abort the function.

Create CSCS Model field file

Background Information:

CSCS Models may also be used on the receiver in the field. This command enables you to create a CSCS Model field file.

Create a CSCS Model field file:

Follow these steps to create a CSCS Model field file.

Step	Action
1	From the **Tools** menu select **Create CSCS Model field file...**.
2	Select a CSCS Model from the list or click on **View** and Add a New CSCS Model.
3	Select the method to define the limits of the CSCS Model field file. Select between **Centre & radius** and **Extents**.
4	Enter the Coordinates of the **Center point** and the **Radius** or enter the Coordinates of the **South-west** and **North-east** corner.
5	Check the **File size**. If you wish to use the file on the System RAM it must not exceed a certain size. Note: The maximum possible file size may vary depending on the free memory in the receivers system RAM. Refer to the Technical Reference Manual on how to free system RAM of the receiver.
6	Click on **Save**.
7	From the browser select the path where the file shall be created.
8	Enter a **File name** without extension. (Extension "csc" will be added automatically)
9	Click on **Save** to confirm. Note: Depending on the file size, this may take a while.

Related Topic:

CSCS Models: Overview

Delete a CSCS Model

Important Information:

- CSCS Models that are currently used in a Coordinate System are indicated by ⚠ and cannot be deleted.

Delete a CSCS Model:

Follow these steps to delete a CSCS Model.

Step	Action
1	Right-click on a CSCS Model in the Tree-View or Report-View and select **Delete**.
2	Press **Yes** to confirm or **No** to exit without deleting.

CSCS Model Properties

Background Information:

This page enables you to display/ edit the CSCS Model Properties.

- CSCS Models that are currently used in a Coordinate System are indicated by ⚠ and cannot be renamed but only modified.

Edit a CSCS Model:

Follow these steps to edit a CSCS Model.

Step	Action
1	Right-click on a CSCS Model in the Report-View or Tree-View and select **Properties**.
2	Make your changes in the page General. Note: Only the fields with white background may be edited.
3	View the extents and spacing of the model in the Extents page.
4	Press **OK** to confirm or **Cancel** to abort the function.

CSCS Model Properties: General

Background Information:

This page enables you to display/ edit the CSCS Model Properties.

- CSCS Models that are currently used in a Coordinate System are indicated by and cannot be renamed but only modified.

General Settings:

Field	Description
Name	Name of the CSCS Model. The Name can only be changed if the CSCS Model is not used in any Coordinate System definition.
Path of Grid file	Path and file name (including the extension .csc). To select from the browser click ....
Method	Displays the Conversion method of the CSCS Model. The Conversion method can be either Grid shifts, Geodetic shifts or Cartesian shifts. It is pre-defined by the CSCS Model Grid file.
Interpolation Method	Displays the Interpolation method used to interpolate a correction value in the grid file. The Interpolation method is pre-defined by the CSCS Model Grid file.
Coord. Type	Displays the Coordinate type with respect to which the grid file is given. The Coordinate type is defined by the CSCS Model Grid file.
Note	Displays the optional note to describe the CSCS Model. The Note may be up to 64 characters long.
Last modified	Date and Time at which the CSCS Model was last modified.

Geoid Model Properties: Extents

Background Information:

This page enables you to display the extents of the Geoid Model.

- CSCS Models that are currently used in a Coordinate System are indicated by and cannot be renamed but only modified.

General Settings:

Field	Description
South-west corner	The coordinates of the lower left (South-west) corner of the model are displayed as local grid coordinates or geodetic coordinates depending on the Coordinate Type of the Geoid model.
North-east corner	The coordinates of the upper right (North-east) corner of the model are displayed as local grid coordinates or geodetic coordinates depending on the Coordinate Type of the Geoid model.
Spacing	The spacing of the grid is displayed according to the Coordinate Type.

OSTN02™ (Great Britain)

OSTN02 is the definitive transformation from ETRS89 to OSGB36 National Grid, which is the British mapping datum. The connected CSCS Model file contains Easting and Northing shifts from preliminary "ETRS89 Eastings and Northings" to the OSGB36 mapping coordinates. The ETRS89 Eastings and Northings are first obtained by applying the British national Transverse Mercator projection with the GRS80 ellipsoid.

OSTN02 was developed by the Ordnance Survey, the national mapping agency of Great Britain, and superceeds the older OSTN97 transformation. Note that OSTN97 is still available within LGO to allow the transformation of existing OSTN97 coordinates to the new OSTN02 coordinates.

OSTN02 consists of a 1250km by 700km grid of translation vectors at 1km resolution. This provides a fit between the GPS coordinate system ETRS89 and the OSGB36 National Grid. OSTN02 is in agreement with major triangulation stations at the level of 0.1m root mean square.

OSTN02 has been developed from the national primary, secondary and tertiary triangulation station network. It contains over 3200 points directly observed by GPS and more than 1000 from the original retriangulation observations adjusted on the ETRS89 datum.

Within Great Britain OSTN02, in conjunction with the ETRS89 positions of the active GPS Network stations, is now the official definition of OSGB36 National Grid coordinate system. This means that using OSTN02 with the National GPS Network, surveyors using GPS have no need to occupy triangulation stations in order to relate GPS coordinates to National Grid coordinates.

More detailed information is available from http://www.gps.gov.uk

To directly convert from WGS84 coordinates in the ETRS89 reference system to the OSGB36 using LGO, define a coordinate system comprising of:

Transformation:	None
Map Projection:	TM
	Central meridian = 2° W
	Latitude of Origin = 49 ° N
	False Easting = 400 000
	False Northing = -100 000
	Scale factor at origin = 0.9996012717
Ellipsoid:	GRS80
CSCS Model:	OSTN02

Note:

- You have to select the GRS80 ellipsoid in the definition of your coordinate system as this is what the preliminary ETRS89 Eastings and Northings coordinates are based upon.

OSTN97™ (Great Britain)

Note:

- The OSTN97 transformation has been superceeded by the definitive transformation OSTN02, by Ordnance Survey Great Britain.
- OSTN97 is still available within LGO to allow the user to transform existing (OSTN97) projects to the new transformation (OSTN02).

OSTN97 is a transformation from ETRS89 to OSGB36 National Grid, which is the British mapping datum. The connected CSCS Model file contains Easting and Northing shifts from preliminary "ETRS89 Eastings and Northings" to the OSGB36 mapping coordinates. The ETRS89 Eastings and Northings are first obtained by applying the British national Transverse Mercator projection with the GRS80 ellipsoid.

OSTN97 was developed by the Ordnance Survey, the national mapping agency of Great Britain.

Ordnance Survey®

OSTN97™ enabled

Detailed information is available from http://www.gps.gov.uk

To directly convert from WGS84 coordinates in the ETRS89 reference system to the OSGB36 using LGO, define a coordinate system comprising of:

Transformation: None

Map Projection: TM

Central meridian = 2° W

Latitude of Origin = 49 ° N

False Easting = 400 000

False Northing = -100 000

Scale factor at origin = 0.9996012717

Ellipsoid: GRS80

CSCS Model: OSTN97

Note:

You have to select the GRS80 ellipsoid in the definition of your coordinate system as this is what the preliminary ETRS89 Eastings and Northings coordinates are based upon.

GR3DF97A (France)

The GR3DF97A is CSCS Model, which contains Cartesian shift corrections needed to convert from the French RGF93 Geodetic Reference System to the new NTF System (Nouvelle Triangulation de la France). A Cartesian shift vector (dX, dY, dZ) is interpolated and applied to get local cartesian coordinates upon which the specified local ellipsoid and map projection is applied to get the final Eastings and Northings.

The table of corrections was provided by the IGN (Institut Geographique National), the French mapping authority. More information can be found at http://www.ign.fr.

To directly convert points given respect to the WGS84 System to the French NTF System, define a coordinate system comprising of:

Transformation:	None
Map Projection:	Select the appropriate map projection.
Ellipsoid:	Clarke 1880 IGN defined by a = 6378249.200 m 1/f = 293.466021
CSCS Model:	GR3DF97A (France)

Note:

A geoid model can be used as well together with this coordinate system.

In case a Classical 3D transformation is used in addition to the CSCS Model, then the transformation and the Cartesian shift of the CSCS Model would be both applied.

ETRS89-RD (Netherlands)

The ETRS89-RD is a transformation from ETRF89 to the National Dutch Grid System RD. The connected CSCS Model file contains Easting and Northing shifts, which are interpolated and applied after the standard Dutch map projection.

To directly convert from WGS84 coordinates in the ETRF89 reference frame to the Dutch RD System using LGO, define a coordinate system comprising of:

Transformation: Classical 3D (Molod. Badekas model)

dX = -593.032 m
dY = -26.000 m
dZ = -478.741 m
Rx = -0.40939”
Ry = 0.35971”
Rz = -1.86849”
Scale factor = -4.0772 ppm

Rotation origin X0: 3904046.180
Rotation origin Y0: 368161.313
Rotation origin Z0: 5013449.047

Map Projection: Dutch Projection

Ellipsoid: Bessel

CSCS Model: ETRS89-RD (Netherlands)

Geoid Model: In order to directly convert to orthometric heights a geoid model can be included as well. The executable, which can be used, is included on the Installation CD and is based on the Geoid Model developed by the Dutch Survey Department.

The table of corrections used in the ETRS89-RD was developed by the Dutch Cadastre, the national mapping agency of the Netherlands.

Detailed information on the Dutch transformation and the Dutch geoid model can be accessed from http://www.rdnap.nl.

Danish CSCS Models

For the Danish territory 6 different CSCS Models are supported. These models provide Eastings and Northings shift corrections, which can be used to directly convert from WGS84 coordinates to the Danish S34 System. The interpolated corrections are applied after the local map projection specified in the Coordinate System.

The supported models are:

DK Jylland (Denmark)
DK Sjelland (Denmark)
DK Bornholm (Denmark)
DK S34 Jylland (Denmark)
DK S34 Sjelland (Denmark)
DK S34 Bornholm (Denmark)

To convert from WGS84 coordinates in the EUREF Reference System to the Danish System 34 coordinates (ED50 Datum) using LGO, define a coordinate system comprising of:

Transformation: Classical 3D (Bursa Wolf Model)

dx = 81.0703 m
dY = 89.3603 m
dz = 115.7526 m
Rx = 0.48488”
Ry = 0.02436”
Rz = 0.41321”

Scale factor = -1.000 ppm

Map Projection: Select one of the 6 Customized Danish map projections:

DK Jylland/ DK S34 Jylland
DK Sjelland/ DK S34 Sjelland
DK Bornholm/ DK S34 Bornholm

Ellipsoid: International (Hayford)

CSCS Model: Select the CSCS Model matching with the selected projection:

DK Jylland (Denmark)/ DK S34 Jylland (Denmark)
DK Sjelland (Denmark)/ DK S34 Sjelland (Denmark)

DK Bornholm (Denmark)/ DK S34 Bornholm (Denmark)

Note:

The *DK S34* map projections and CSCS models have to be used to make the Easting coordinates run positive towards the West.

SWEREF99RT90 (Sweden)

SWEREF99RT90 is a transformation from SWEREF 99, which is the Swedish realization of ETRS 89, to RT 90, which is the old Swedish National Coordinate Datum. The connected CSCS Model file contains corrections to latitudes and longitudes, which can be used to directly convert from SWEREF 99 to RT 90 without any 3D transformation. In addition to the datum shift, the corrections also include the distortions in the RT 90 system.

The model defines the differences RT 90 minus SWEREF 99 on a grid of points given at a spacing of 0.02° in latitude and 0.04° in longitude (approx. 2 km). Corrections for any point will be computed by a bilinear interpolation between four neighbouring points of the grid.

SWEREF99RT90 was developed by Lantmäteriet, the National Land Survey of Sweden. (http://www.lantmateriet.se)

Version 2 of SWEREF99RT90 contains corrections in 301176 points of the grid, computed from coordinates of 8400 stations determined in the two systems by the on-going project RIX 95. The coverage of the model can be seen on the map below and will be expanded as the project is completed. The range of the grid is 54° to 70° in latitude and 10° to 25° in longitude.

Detailed information is available from http://www.lantmateriet.se/geodesi.

To convert coordinates from SWEREF 99 (corresponds to WGS84) to RT 90, define a coordinate system comprising of:

Transformation: None

Ellipsoid: Bessel

CSCS Model: SWEREF99RT90

Any map projection and additionally a geoid model may be used.

The RT 90 coordinates will then be displayed as your local coordinates in LGO.

NZGD49-2000 (New Zealand)

The **New Zealand Geodetic Datum 2000** (NZGD2000) is a new geocentric coordinate system, which replaces the older **New Zealand Geodetic Datum 1949** (NZGD49). The new NZGD2000 uses the GRS80 ellipsoid and a set of Transverse Mercator projections (for details see http://www.linz.govt.nz/staticpages/pdfs/linzpublications/factsht_may99.pdf.

The **NZGD49-2000 CSCS Model** defines the differences between NZGD2000 and NZGD49 latitudes and longitudes on a grid of points given at spacings of 6 arcseconds (approx. 20 km) across the land area of New Zealand.

The grid file has been developed by Land Information New Zealand (LINZ).

Detailed information is available on:
http://www.linz.govt.nz/rcs/linz/pub/web/root/core/SurveySystem/GeodeticInfo/GeodeticDatums/nzgd2000factsheet/index.jsp.

To convert coordinates from NZGD2000 (corresponds to WGS84) to NZGD49, define a coordinate system comprising of:

Transformation:	None
Ellipsoid:	International (Hayford)
CSCS Model:	NZGD49-2000

Any map projection and additionally a geoid model may be used.

The NZGD49 coordinates will then be displayed as your local coordinates in LGO.

For working directly in NZGD2000 simply apply a coordinate system comprising of one of the new map projections and the GRS80 ellipsoid. Choose transformation and CSCS Model **None** then.

NADCON (U.S.A.)

NADCON is the standard for conversions between the old North American Datum of 1927 (NAD27) and the readjusted North American Datum of 1983 (NAD83).The shift between the two datums is given by a grid of geodetic correction values provides by the NGS.

For detailed information please refer to http://www.ngs.noaa.gov/TOOLS/Nadcon/Nadcon.html. Grid files containing the corrections are available there as well.

The NADCON conversion is supported in LGO through Geodetic CSCS Models. Three NADCON CSCS models (for the Conterminous US, for Alaska and for Hawaii) are pre-installed in the Coordinate System Management:

NADCON ConUS

NADCON Alaska

NADCON Hawaii

To convert coordinates between NAD83 (corresponds to WGS84) and NAD27, define a coordinate system comprising of:

Transformation: None

Ellipsoid: Clarke 1866

CSCS Model: NADCON

Any map projection or State Plane Zone and additionally a geoid model may be used.

Enter NAD83 coordinates as WGS84 coordinates, and the NAD27 coordinates will be displayed as your local coordinates in LGO.

Other grid conversion files for the conversion between North American Datums, which are available from the NGS can also be used. Download the LAS and LOS files containing the correction values in latitude and longitude, convert it to the Leica CSC file structure and add a new CSCS Model.

Grid files for conversions between NAD83 and NAD27 are also available for **Canada** from the appropriate government agencies, and can be converted for further use as a CSCS Model in LGO. For more information on CSCS models for Canada and on how to convert binary grid files into Leica CSCS Model files please refer to: Other CSCS Models.

Other CSCS Models

LGO accesses CSCS Model corrections from a binary CSC file strucure. For models for which the correction files have to be downloaded or purchased from the corresponding mapping authority it may thus be necessary to convert the files to LGO's binary CSC file format. For certain files you can do so using the tool CSCSModelConvert.EXE located in the ...\LEICA Geo Office\Combined\Bin directory of your installation. Contact your local Leica representative for further assistance.

Models that can be converted using this tool are:

Canadian ATS-77 Datums for:

- Nova Scotia (East / West)
- Prince Edward Island
- Ne w Brunswick

The conversion tool provides the conversion from the NTv2 (*.GSB) file structure to the Leica CSC file structure. Start the tool, select NTv2 files (*.GSB), browse to the GSB file as the Input File and select an Output file name. The converted CSC file can be used to add a new CSCS Model.

Note that for Nova Scotia also the older *.DAC file structure can be converted. Select NTv1 files (*.DAC) in the conversion tool to create the CSC file.

Canadian NADCON files:

Files containing geodetic corrections between NAD27 and NAD83 are available for Canada in the NTv2 (*.GSB) file format. Refer to the Geodetic Survey of Canada website http://www.geod.nrcan-rncan.gc.ca or to the ...\Common folder of your LGO installation CD.

The *.GSB files can be converted to LGO's CSC file structure. Select NTv2 files (*.GSB) in the CSCSModelConvert.EXE tool. The converted files are also available in the ...\Common folder of your LGO installation CD.

Australian Datum conversions:

Australia is changing to a new corodinate system, the so called Geocentric Datum of Australia (GDA). Grid files containing the corrections in latitude and longitude between the old Australian Geodetic Datum (AGD) and the new GDA are available in the NTv2 file format (*.GSB). To create a CSCS Model from these correction download the files and convert them to the Leica CSC file format using the CSCSModelConvert.EXE tool.

Detailed information and the links for downloading the GSB files are available from the Intergovernmental Committee on Surveying and Mapping (ICSM). Please refer to the GDA Technical Manual at http://www.anzlic.org.au/icsm/gdatm/chapter7.htm.

Switzerland:

For Switzerland it is possible to directly obtain a LGO CSC file containing the corrections between the new LV95 and the older LV03 datum. Contact your local Leica representative for further information.

This CSCS Model is an approximation for the official FINELTRA transformation. Whereas the Fineltra transformation models the distortions between LV95 and LV03 with sets of affine transformations valid for triangles built from points where coordinates in LV95 and LV03 are given, the CSCS Model is built on a regular grid of 1 km spacing calculated using the Fineltra program.

The correction file was developed by the Bundesamt für Landestopographie. (http://www.swisstopo.ch)

To convert WGS84 coordinates in the CHTRS95 reference system to the CH1903 datum using LGO, define a coordinate system comprising of:

Transformation	Classical 3D (Bursa Wolf model) dX = -674.374 m dY = -15.056 m dZ = -405.346 m
Map Projection	Swiss
Ellipsoid	Bessel
CSCS Model	use the CSCS model described above

To work in LV95 select the Swiss95 projection and de-select the CSCS model.

Programs

Example of a User-written Program

The following example shows a User–written Program (written in Turbo Pascal) for the Swiss Projection. It transforms Swiss Grid coordinates to Geodetic coordinates (and vice versa). This map Projection is already included as a customized Projection.

The line numbers at the beginning of each line are for reference only. They do not constitute part of the source code.

```
Program CH_Projection_Set;
const
pi= 3.1415926535;
eps= 1.0e-10; {convergence limit}
{constants for Bessel ellipsoid}
ae= 6377397.155; {semi major axis}
ex2= 0.006674372231; {e squared}
lato= 46.952405556; {ell. latitude of Bern}
lono= 7.439583333*pi/180; {ell. longitude of Bern}
{derived constants for sphere}
r = 6378815.9036; {radius}
alpha = 1.00072913847; {scale factor along meridian through Bern}
rk = 0.00306673233; {integration constant}
bo= 46.907731456*pi/180; {spherical latitude of Bern}
var dumy: extended;
y,x,h,y1,x1: extended;
lquer,bquer,wert,wert1,wert2,bk,lk: extended;
cobo,sibo,cobi,sibi,coli,sili: extended;
ex,lati,loni,ritko: extended;
id: integer;
a,b: text;
```

```
{********* Main Program *********}
begin
{Assign and open files}
assign(a,'input.usr');
reset(a);
assign(b,'output.usr');
rewrite(b);
{Read the first 3 lines}
readln(a,id); {read type}
readln(a,dumy); {read semi-major axis, (not used, fixed programmed)}
readln(a,dumy); {read flattening, (not used,fixed programmed)}
if id = 1 then begin
{Transformation ELLIPSOID to GRID coordinates}
while not EOF(a) do begin
readln(a,lati,loni);
{transformation ellipsoid to sphere}
ex:= sqrt(ex2);
wert1:= pi/4.0+lati/2.0;
wert1:= alpha*ln(sin(wert1)/cos(wert1));
wert2:= ln((1.0+ex*sin(lati))/(1.0-ex*sin(lati)));
wert:= exp(wert1-(alpha*ex/2.0*wert2)+rk);
bk:= 2.0*(arctan(wert)-pi/4.0);
lk:= alpha*(loni-lono);
{transformation sphere to sphere}
```

```
cobo:= cos(bo);
sibo:= sin(bo);
cobi:= cos(bk);
sibi:= sin(bk);
coli:= cos(lk);
sili:= sin(lk);
wert1:= cobo*sibi-sibo*cobi*coli;
bquer:= arctan(wert1/(sqrt(1.0-wert1*wert1)));
lquer:= arctan(cobi*sili/(sibo*sibi+cobo*cobi*coli));

{transformation sphere to plane}
x1:= r/2.0*ln((1.0+sin(bquer))/(1.0-sin(bquer)));
y1:= r*lquer;

{transformation civil to military coordinates}
x:= x1+200000.0;
y:= y1+600000.0;

{output}
writeln(b,y:15:4,x:15:4);
end;
end;

if id = 2 then begin

{Transformation GRID to ELLIPSOID}

while not EOF(a) do begin
readln(a,y,x);

{transformation military to civil coordinates}
y1:= y-600000.0;
x1:= x-200000.0;

{transformation plane to sphere}
lquer:= y1/r;
```

```
bquer:= 2.0*(arctan(exp(x1/r))-pi/4.0);

{transformation sphere to sphere}
cobo:= cos(bo);
sibo:= sin(bo);
cobi:= cos(bquer);
sibi:= sin(bquer);
coli:= cos(lquer);
sili:= sin(lquer);
wert:= cobo*sibi+sibo*cobi*coli;
bk:= arctan(wert/(sqrt(1.0-wert*wert)));
lk:= arctan(cobi*sili/(cobo*cobi*coli-sibo*sibi));

{transformation sphere to ellipsoid}
ex:= sqrt(ex2);
lati:= bk;
repeat
ritko:= lati;
wert1:= pi/4.0+bk/2.0;
wert1:= sin(wert1)/cos(wert1);
wert1:= ln(wert1)/alpha;
wert2:= ln((1.0+ex*sin(lati))/(1.0-ex*sin(lati)))*ex/2.0;
lati:= 2.0*(arctan(exp(wert1+wert2-rk/alpha))-pi/4.0);
until (abs(ritko-lati)<eps);
loni:=lono+lk/alpha;

{output}
writeln(b,lati:15:12,loni:15:12);
end;
end;
close(a);
close(b);
end.
```

There are a few minor constraints in the user written program that must be observed in order to be able to integrate it into a user–defined Projection set:

Line	Description
034	The file name for the file containing the coordinates that are to be transformed (for grid coordinates as well as for geodetic coordinates) has to be INPUT.USR
036	The name of the file to output the transformed coordinates (for Grid coordinates as well as for Geodetic coordinates) has to be OUTPUT.USR
041	The first line of the INPUT.USR file containing the information flag for the type of coordinates is read in: 1 = geodetic coordinates. 2 = grid coordinates.
042	The second line of the INPUT.USR file containing the value for the semi–major axis of the reference ellipsoid is read in. In this example the value is not used because it is implicitly stated in the program parameters.
043	The third line of the INPUT.USR file containing the value for the flattening of the reference ellipsoid is read in. In this example the value is not used because it is implicitly stated in the program parameters.
046	The switch is set to transform from Geodetic to Grid coordinates.
051	The rest of the lines of the INPUT.USR file containing, in this case, Geodetic coordinates (latitude and longitude, in radians) are read in.
082	The resultant Grid coordinates are written to the OUTPUT.USR file. First Easting then Northing.
086	The switch is set to transform from Grid to Geodetic coordinates.
091	The rest of the lines of the INPUT.USR file containing, in this case, Grid coordinates (Easting and Northing) are read in.
126	The resultant Geodetic coordinates are written to the OUTPUT.USR file, first latitude then longitude (in radians).

File Format of INPUT.USR and OUTPUT.USR

Whenever LGO converts Grid coordinates to Geodetic coordinates or vice versa, intermediate files are created internally which are passed to the applied Projection program. In the case of a User-defined program, the programmer has to know the format of these intermediate files.

Input.usr

This is the file, which has to be accessed to read in the coordinates to be converted into the user defined map Projection program.

Line 1

- Flag for identification of coordinate type:
- 1 = geodetic coordinates
- 2 = grid coordinates

Line 2

- Semi-major axis of reference ellipsoid.

Line 3

- Flattening of reference ellipsoid.

Following lines

Each line contains:

- in case of geodetic coordinates: latitude and longitude (in radians) for one point.
- in case of grid coordinates: easting and northing for one point.

Example of INPUT.USR file for geodetic coordinates:

```
1

6378137.000

0.003352810665

0.826317296827 0.167522411309

0.826317295438 0.167522411668

0.826317295735 0.167522412147

0.826317296574 0.167522411113

0.826317295208 0.167522411696

0.826317294691 0.167522410838

0.826317293977 0.167522410262

0.826317295626 0.167522410202

0.826317295911 0.167522411033

0.826317295738 0.167522410997
```

Example of INPUT.USR file for grid coordinates:

```
2

6378137.000

0.003352810665

763092.409 245766.864

763092.411 245766.855

763092.413 245766.857

763092.408 245766.862
```

```
763092.411 245766.854

763092.407 245766.850

763092.405 245766.845

763092.405 245766.856

763092.408 245766.858

763092.408 245766.857
```

Output.usr

This is the file into which the result of the Projection conversion, (i.e. the converted coordinates) has to be written.

All lines

Each line contains:

- in case of grid coordinates output: easting and northing for one point.
- in case of geodetic coordinates output: latitude and longitude (in radians) for one point.

Example of OUTPUT.USR file for grid coordinates:

```
763092.409 245766.864

763092.411 245766.855

763092.413 245766.857

763092.408 245766.862

763092.411 245766.854

763092.407 245766.850

763092.405 245766.845

763092.405 245766.856
```

```
763092.408 245766.858

763092.408 245766.857
```

Example of OUTPUT.USR file for geodetic coordinates:

```
0.826317296864 0.167522411279

0.826317295443 0.167522411684

0.826317295748 0.167522412158

0.826317296554 0.167522411036

0.826317295286 0.167522411677

0.826317294676 0.167522410728

0.826317293899 0.167522410235

0.826317295626 0.167522410305

0.826317295927 0.167522411010

0.826317295770 0.167522411004
```

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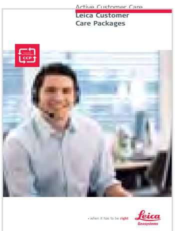

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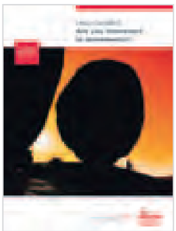

Software:
Leica GeoMoS
Leica GNSS Spider
Leica GNSS QC
Leica GeoMoS Web

Total Stations:
Leica TCA1800/2003
Leica TCA1201M
Leica TPS1200 Series

GPS/GNSS:
Leica GMX902 GG
Leica GRX1200 Series
Leica GPS1200 Series
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